School Nutrition Policy Adherence and Weight Status in Elementary School Children in Prince Edward Island

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Abstract

The majority of Canadian provinces have adopted school nutrition policies (SNP) in an effort to improve children's eating habits and reduce childhood overweight and obesity. While a number of provinces have implemented SNPs, there has been little in terms of evaluation across the country. All elementary schools in Prince Edward Island (PEI) adopted a SNP in 2005-2006. The purpose of this study was to describe the changes in SNP adherence over time, as well as assess the impact that SNP adherence has on children's overweight and obesity rates. A self-administered survey was distributed to all elementary school principals in 2007 and 2010. The Principal School Food Survey (Appendix A) consisted of both a subjective and more objective component to assess the level of implementation of all SNP elements. The perceived adherence score was calculated using the responses from 15 subjective questions. Food list adherence, the more objective measure of adherence, was assessed by comparing the reported food and beverage items sold at lunch, in vending machines and canteens to policy guidelines. The relationship between overweight and obesity rates and both measures of adherence was assessed for 2010 only. It was predicted that schools with a higher level of adherence would have lower rates of overweight and obesity. Non-parametric tests (Wilcoxon rank sum, chi-square and Spearman's rho) were used to assess changes in perceived adherence, food list adherence and the agreement between food list and perceived adherence respectively. Logistic regression was used to assess the impact that the level of policy adherence had on overweight and obesity rates.

Results indicated that perceived adherence was higher in 2010 than 2007 (Mann-Whitney U= 519.5, p =0.007). Food list adherence for lunch program items and canteen items decreased significantly from 2007 to 2010 (x^2= 12.576, df=3, p=0.006) while vending machines item adherence increased slightly during the same time period (x^2=13.689, df=1, p=0.008). There was no significant agreement between overall perceived adherence scores and food list adherence; however, a few policy elements (pricing foods to encourage healthy consumption, promote healthy advertising, serve foods from 'most often' or 'sometimes' list) did reveal a positive relationship with 2007 food list adherence.

There was some support for the hypothesis for the overweight model, in that closer policy adherence (% allowed foods) was associated with lower overweight rates in elementary school children. The study also found that schools with higher perceived adherence scores had increased rates of overweight among grade 5 and 6 children. The level of adherence was not, however, a significant predictor of obesity rates. These findings are consistent with previous research demonstrating the impact of SNP adherence on overweight rates but not obesity. This study also found that physical activity, breakfast consumption, low-nutrient density food (LNDF) consumption, student sex and parental education were significant predictors of both overweight and obesity; in addition to these factors, parental income and television frequency were also predictors of obesity. The relationships between the co-variates and overweight and obesity were in the

expected direction. While the adoption of a SNP can be a positive first step to change the school food environment, promote healthy eating habits and reduce overweight among children, more comprehensive evaluation methods (ie. objectively assessing adherence to all policy elements as opposed to just available food and beverage items) are needed to identify potential barriers to implementation and accurately assess the impact of such policy interventions.

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Chapter 1: Introduction

The prevalence of childhood obesity is increasing worldwide, and Canada has witnessed a tripling of childhood obesity rates in the past 25 years.[1-9] In 2004, it was reported that 22.4% of Prince Edward Island (PEI) children were overweight, and 7.8% were obese.[9] There are various documented contributors to obesity, such as poor nutrition, lack of physical activity, genetics, home environment, developmental factors, and medical issues.[1,2,7,10] Childhood obesity can lead to an increased risk for Type 2 diabetes, cardiovascular disease, hypertension, and stroke.[2,6,10-12] The increased prevalence of childhood obesity and the higher risks of co-morbidities have caused an increased awareness of the need for prevention strategies to decrease overweight and obesity rates. Overweight and obese children are more likely to be overweight or obese adults,[1,3,6,10] so it is very important to establish healthy lifestyle behaviours during childhood.

Schools have been identified as a logical environment for addressing the problem the childhood overweight and obesity. Students spend seven hours per day and five days per week at school, where they consume one to two meals each day; children are also able to learn and develop health habits in the school environment that can carry into adulthood.[13-16] As a result of the increasing rates of childhood overweight and obesity, school nutrition policies (SNPs) have been adopted and become a popular obesity prevention strategy.[13,16-18] Research to date evaluating SNPs[19-29] has been limited, with most being conducted in the United States (U.S.).[19-22,24-27,29] Some studies[19,20,22,23,26] have evaluated SNPs by comparing the change in the food environment (usually lunch) before and after SNP adoption, whereas others[21,25,27,29] compared students in schools with and

without a policy.

Most SNPs are designed to improve children's eating habits and ultimately reduce and prevent overweight and obesity. However, it is very difficult to determine whether SNPs are effective if school adherence to the policy is not assessed.[17,30] American studies that have examined SNP adherence in different food environments (lunch, canteen, and vending machine) have reported that adherence varies within the school.[19,20,22] Foods and beverages offered in canteens and vending machines tend to be less likely to adhere to policy guidelines than those offered in the National School Lunch Program. Similar Canadian studies are lacking and this could, in part, be due to a lack of national guidelines and the variation in provincial/territorial SNPs, which has resulted in provinces and school districts designing their own surveys of food available at school with the information collected varying among provinces.[13] It is for these reasons that caution must be taken when applying U.S. findings in Canadian context.

School principals tend to be primarily responsible for implementing SNPs.[20,28,31] It has been found that policy adoption can be high or low depending on the principals' interest, resources, knowledge, beliefs, fatigue, and whether policy adoption is a priority for the school.[32] A few studies[23,28] have explored principals' perceptions of nutrition policies, but changes in such perceptions over time has not been assessed.

The School Nutrition and Physical Activity (SNAP) Project, a 5-year study evaluating the effect of SNPs on children's eating habits and obesity rates in PEI has assessed both principals' perceived adherence and a more objective method termed 'food list adherence' from 2007 to 2010. Principals' perceived adherence consists of

principals' self-reported adherence to each policy guideline using the Principal School Food Survey (Appendix A). Food list adherence is determined by assessing the nutrient content of each food and beverage item against policy guidelines to determine if it is an 'allowed' item. It is important to assess both food list adherence and principals' perceptions of adherence over time in order to account for and fully examine the level of SNP adoption in each school. While the level of adherence to the SNP has been assessed in each year of data collection, the change in adherence over time has not yet been reported.

Currently, there are very few studies that have examined the effectiveness of SNPs and the impact they have on reducing children's overweight and obesity rates[15,17]. The research described in this thesis is part of the SNAP Project and will attempt to increase the understanding of the role of SNPs and their impact on children's weight status. The purpose of my research is to assess the association between SNP adherence (perceived and food list) from 2007 to 2010, as well as the impact on overweight and obesity rates among grade five and six children in PEI elementary schools in 2010. This study will use data from the SNAP project's 2007 and 2010 data collection periods.

This research will be guided by the following objectives:

Research Objectives

1. To describe principals' perceived adherence to policy elements one and four years after policy adoption (in 2007 and 2010).

2. To describe food list adherence in all school food environments (lunch, canteen, and vending machine) one and four years after policy

adoption (in 2007 and 2010).

3. To examine the agreement between perceived adherence and food list adherence one and four years after policy adoption (in 2007 and 2010).

4. To examine the association between the level of policy adherence and overweight and obesity rates in children in 2010.

Chapter 2: Literature Review

Obesity

Defining Childhood Obesity

Childhood obesity is a medical condition in which excess body fat negatively affects a child's health and well-being and is the result of an imbalance between caloric intake and energy expenditure.[1,3,33] Overweight and obesity are typically defined in terms of Body Mass Index (BMI).[5,33,34] BMI is defined as an individual's body weight divided by the square of his or her height and has been used widely in adult populations. However, the use of BMI to assess overweight and obesity in children is more controversial because BMI changes substantially with age.[1,34] Children are still growing, and the accuracy of the ratio to predict level of body fat may not be as high for children as it is for adults.

Several reference percentiles and age specific cut-off points have been developed to assess overweight and obesity in children.[1,3,5] The prevalence estimates of overweight and obesity among children vary according to the method used. The three most commonly used methods use growth curves and cut points developed by the World Health Organization (WHO), the International Obesity Task Force (IOTF), and the US Centers for Disease Control (CDC). The prevalence estimates of overweight and obesity have been shown to be similar when based on WHO and CDC cut-points but are lower when based on IOTF cut-points. The IOTF cut-points are commonly used for population based studies involving the surveillance of overweight and obesity rates.[35] To determine the IOTF BMI cut-off points, Cole et al. used a reference population that was obtained by averaging across a heterogeneous mix of surveys from different countries with

varying prevalence rates for obesity.[34] For each of the surveys, percentile curves were drawn. At age 18 years, the curve passed through the widely used cut-off points of 25 and 30 kg/m^2 for adult overweight and obesity. The resulting curves were averaged to provide age- and sex-specific cut-off points from 2 to 18 years.[34] Although the terminology (overweight and obese) used by Cole et al. corresponds to adult cut-off points, the health consequences for children who exceed the age-and-sex-specific BMI cut-off points may differ from the health consequences of adults.[34]

Prevalence of Childhood Obesity

National surveys have revealed high numbers of overweight and obese children.[9,10,12] In 2004, the Canadian Community Health Survey (CCHS) reported that 18% of Canadian children aged 2- to 17- year-olds were overweight and 8% were obese, a combined rate of 26% of children. Prior to the 2004 CCHS, the last nationally representative survey of children's heights and weights was in 1978. The most noticeable increase in children's overweight and obesity rates from 1978 to 2004 was the percentage of adolescents whose BMIs exceeded 25 or 30 kg/m^2, the overweight and obese thresholds for adults. The 2004 CCHS indicated that obesity rates varied throughout the country, with the highest rates found in the Atlantic Provinces.[9,10] In PEI, 22.4% of children have been reported to be overweight, with 7.8% being obese.[9]

Consequences of Obesity

It has been documented that obesity increases the risk for lifelong and life-threatening medical conditions, such as Type 2 diabetes, cardiovascular disease, hypertension, stroke, gallbladder disease, osteoarthritis, sleep apnea, and at least eight different cancers.[3,6,10,12,31] Since obesity in childhood and adolescence is predictive of

adult obesity, it is very important to prevent obesity in children to decrease the risk for obesity and these associated health consequences later in life.[9,12]

The consequences of childhood obesity are not only physical. Children can experience emotional consequences, such as low self-esteem, negative body image, and depression, as well as social consequences, such as feeling judged and being teased or bullied.[10] The increasing prevalence of childhood obesity, along with the associated medical conditions, leads to a diminished quality and quantity of life. This threatens both the overall health status of Canadians and the sustainability of the Canadian health care system.[10-12]

Childhood Obesity Risk Factors

While the increasing prevalence of childhood obesity has been well documented, the specific causes of obesity are less clear. The basic physiology of weight gain is understood (energy intake that exceeds expenditure), but there is a complexity of factors contributing to increasing obesity rates.[1,10,12] Weight gain among children is likely caused by a combination of risk factors, including environmental factors, genetics, and social factors.[1,9-12]

Environmental factors, such as diet and physical activity, are considered to be among the most significant contributing factors.[1,10] Poor dietary habits are generally linked with increased intake of energy-dense foods and higher rates of overweight and obesity. Recent studies examined the links between the consumption of certain types of food and obesity.[1,11,13] It is suggested that foods that are high in calories, fat, and sugar as well as sweetened drinks may contribute to overweight and obesity.[9,14,36] The results

from the 2004 CCHS data indicated that 59% of Canadian children and adolescents consumed fruits and vegetables less than five times per day, and these children were more likely to be overweight or obese compared with children who ate fruits and vegetables more frequently.[9]

Decreased physical activity has also been implicated as a primary contributor to childhood obesity.[1,9,10,37] Sedentary activity of more than one hour per day has been associated with a significantly increased risk for being overweight, whereas participating in physical activity more than seven times per week was associated with a decreased risk for being overweight.[1,9,35] The increased amount of screen time, which is the term used to refer to time spent watching television, playing video games, and using the computer, has been a major contributor to the decreased level of physical activity in children.[1,36] It was found that more than one-third (36%) of Canadian children aged 6 to 11 years registered more than 2 hours of screen time each day.[9] These children were twice as likely to be overweight or obese compared with children whose daily screen time was 1 hour or less. Screen time has also been measured on a weekly basis for adolescents aged 12 to 17 years. Overweight or obesity rates ranged from 23% for those who logged less than 10 hours of screen time per week to 35% for those who logged 30 or more hours per week.[9]

Genetics have been identified as a risk factor for childhood obesity; however, the strength of the influence is unknown.[7,8] Genetics do not change drastically over a generation, so it is difficult to state that genetics is responsible for such a high increase in obesity prevalence in a few decades.[7] Although dietary and lifestyle habits are not genetic, families tend to share these behaviours, and parents have a significant influence

on what their children eat and their activity levels, both of which can contribute to obesity.

Social factors, such as income and education, can also affect an individual's caloric intake and energy expenditure.[1,7,9-11] As household income increases, the probability that a school-aged child will be overweight or at risk for becoming overweight decreases.[9,11] According to the 2004 CCHS, children and adolescents in middle-income households were more likely to be overweight or obese than those in high-income households.[9] Childhood obesity may be more prevalent in low-income families, because high-calorie processed foods cost less and are easier to find and prepare than healthier foods. Income can also influence childhood obesity as low-income families may have inadequate access to safe recreational places, limiting opportunities for physical activity.[1,9,11] The 2004 CCHS found a stronger association between childhood obesity and parental education. The results indicate that children and adolescents in households where members had no more than a high school diploma were more likely to be overweight or obese than children in households where the highest level of education was post secondary.[9]

Obesity Prevention through School Nutrition Policies (SNPs)

Prevention can be an effective way to reduce the prevalence of childhood obesity and its associated negative impacts, and most agree that efforts to halt this growing epidemic must start in childhood and target important lifestyle behaviours, including dietary practices.[13,14,31,39] Creating environments to improve children's diets and their physical activity levels tends to be the primary focus of prevention initiatives.[31] In recent years, policy changes involving the school food environment have been one of the

most frequently proposed measures to address childhood obesity. Unlike public health interventions that target individual behaviours, SNPs focus on changing the school food environment.[24] SNPs have become a popular obesity prevention strategy, because students consume one to two meals per day at school and because schools are a logical environment to foster nutrition education.[13,14,16,40] Some research[20,23,29] suggests that schools can play an important role in promoting healthy eating by improving the quality of food and beverage items available at school and encouraging healthy food choices, which, in turn, can empower students to consume healthier meals. School-related factors have also been identified as important and potentially powerful predictors of youth dietary behaviour. These factors include, but are not limited to, food and beverage items offered in vending machines, a la carte programs, school stores, foods used as rewards and incentives and school fund-raising initiatives.[30,31,40] It was also found that schools permitting frequent snacking throughout the day and the consumption of food and beverages high in calories and low in nutrients tend to have more overweight and obese children than schools that discouraged these practices.[39] Nutrition policies are not only focused on increasing students' knowledge of nutrition and healthy lifestyle behaviours but also on reducing or eliminating school-related factors contributing to weight gain[15].

SNPs are also considered an ideal environment for prevention strategies because schools are able to reach a large number of children. Statistics Canada reported that 5.2 million Canadian children were enrolled in public elementary and secondary schools in 2006/2007.[41] In a review on the role of schools in obesity prevention, Story et al (2006) noted that schools were an ideal environment such efforts because "no other institution has as much continuous and intensive contact with children during their first two

decades of life".[42] It has also been reported that policies adopted during the elementary school years have been influential in the development of healthy behaviours in children, and these behavioural changes can affect obesity, in both short-term and long-term.[13,15,31] It has been acknowledged that schools alone cannot solve the childhood obesity epidemic, but it is also unlikely that childhood obesity rates can be reversed without strong school-based policies to support healthy eating and physical activity.[13,15] Policy makers have recognized the educational effect that schools have on children and acknowledge the important role schools can play in the effort to control and prevent childhood obesity by fostering healthy lifestyles through education.[13] As a result, SNPs have been adopted by the majority of developed countries, and by almost all provinces and territories in Canada. A discussion of the PEI School Nutrition Policy follows.[13,43]

PEI School Nutrition Policy

A SNP was first adopted in PEI elementary schools in 2006; this initial policy was expanded by 2008 to apply to all grades. However, this thesis focuses on the elementary school nutrition policy only. The policy states that it aims to improve student access to healthy, safe, reasonably priced, attractively presented food choices and to reduce hunger among children living with food insecurity through enhanced access to healthy foods within the school setting.[44] By providing healthy food and beverage choices in school lunch programs, vending machines and canteens, the policy will improve the quality of food available to the student. Furthermore, healthy food choices or nonfood items are recommended to be used for fund-raising activities, campaigns, and student rewards. In terms of nutrition education, the policy indicates that it is important and most effective if a comprehensive approach involving the school and

broader community is used.[44] PEI's policy states that teachers and school staff are important resources in fostering students' understanding of the relationship between nutrition, health, and physical activity. The development of children's nutrition knowledge is an important aspect of this policy, as well as the encouragement for children to acquire positive attitudes and skills necessary to make healthy food choices for life.

The PEI SNP guidelines outline which food and beverage items are 'allowed' to be available to students. There is a list for food and beverage items in canteens, school lunch programs, and breakfast programs and a list for beverages in vending machines.[44] The criteria for the food available at school falls into three distinct categories: 'Food to Serve Most Often', 'Food to Serve Sometimes', and 'Food to Serve Least Often'.[44] Detailed guides indicating which foods can be served in each category as well as the nutrient criteria for each list can be found in Appendices B-D. The 'Food to Serve Most Often' list contains foods that should be the main focus of a healthy diet and emphasizes vegetables, fruits, and grain products. Foods in this list tend to be low in fat, sugar, and sodium. It is recommended that foods from this list are served daily. The 'Food to Serve Sometimes' list consists of foods that are also healthy choices but are higher in calories, fat, sugar, and salt and/or are more processed. No more than two food items from each column in the 'Sometimes' list should be served each week. Foods from the 'Food to Serve Least Often' list tend to be high in fat, sugar, salt, and calories or offer little nutritional value. No more than two food items from the entire 'Least Often' list should be served each month. Although it is advised that items from the 'Least Often' list be avoided most of the time, the policy indicates they can fit into a healthy diet once in a

while.[44]

The policy element regarding fund-raising at school refers to fund-raising activities being centered on non-food products or healthy food choices from the 'Foods to Serve Most Often' list or the 'Food to Serve Sometimes' list. The element of the policy regarding the nutrition education curriculum specifies that nutrition education will be incorporated into other subjects when possible.

Evaluating School Nutrition Policies

Comprehensive approaches to evaluating SNPs are recommended to assist in improving policy content, enhancing policy support and adherence, ensuring that policies are meeting their objectives, and responding to the changing needs of governments and schools.[13,16,17] There are existing tools to evaluate SNPs for their comprehensiveness and stringency of guidelines, but the variation in these evaluation tools makes it difficult to compare results or standardize policies.[17] The U.S. School Health Policies and Programs study collects detailed information on food and beverages at the state, district, and school level every six years to evaluate the National School Lunch Program.[17] There is no comparable national data collected in Canada but many jurisdictions are planning some form of evaluation for their SNPs.[16] Provinces and school districts have designed their own surveys of food sold and served at school, but the detail and information collected varies among provinces as a standardized evaluation framework and validated method assessing policy outcomes is still unavailable.[17] There are also only a few provinces assessing whether specific foods are consistent with the standards of the SNP; most provinces are addressing progress in removing unhealthy food and beverages and/or changes in fundraising activities.[43]

Prince Edward Island has utilized a comprehensive approach to evaluate SNPs by assessing food and nutrient intakes, perceptions of stakeholders, and measures of implementation[23,28]. In 2007, the SNAP project began monitoring and evaluating the effect of PEI's school nutrition policy on children's dietary intakes and weight status.[44] In 2007 and 2010, the food habits and weight status of students in grades five and six were assessed, as well as the principals' perceived level of adherence to food policy. The SNAP team assessed the nutritional benefits of the new policy by examining changes in student food consumption from 2007 to 2012 to provide important information regarding the effectiveness of SNPs over time.[23,45] To date, the findings of SNAP indicate that students consume fewer low-nutrient dense foods and are more likely to meet Health Canada's recommendation for Vegetables and Fruits and Milk and Alternatives after the introduction of a nutrition policy compared with the same students' pre-adoption levels.[23] Mullally et al used food consumption data from SNAP and compared back to pre-SNAP policy and the findings mentioned above were the first piece of evidence to show favorable changes in student food consumption after the adoption of a SNP in Canada. However, Mullally and colleagues[23] did not consider the school's adherence to the policy nor its impact on overweight and obesity, so firm conclusions that the policy produced these changes cannot be made. There have been similar studies in Nova Scotia[25] and California[19,29], which found significant improvements in eating habits and a decline in the rate of overweight children attending schools with a more comprehensive policy than no policy at all. Unfortunately, these studies did not examine the impact of the nutrition guidelines alone or consider the level of implementation at each school.[25,29] It has been recommended that more research examining the impact of SNP which considers policy adherence is needed.[17]

School Nutrition Policy Adherence

To be effective in changing behaviour and meeting policy goals, school nutrition and health policies must be adopted and adhered to fully.[13,21] The adoption of a SNP is an important first step; however, it is essential to assess the extent to which SNPs are implemented in order to gauge their success at improving dietary intakes and/or reducing overweight and obesity.[14,18,22] Assessing each school's level of SNP adherence is a considerable challenge in Canada.[17] This challenge is caused by the variation in the nature of policies and their implementation within provinces and districts. Another challenge when evaluating SNP adherence is the variation in food services between provinces and school districts. Large companies may have food composition data available; however, smaller companies may not have detailed composition data to determine if food and beverage items are 'allowed' according to policy guidelines.[43] To successfully contribute to reversing the obesity epidemic, experts suggest that there is a need for a comprehensive and systematically enforced set of strong SNP guidelines.[14,29] Further, it is unlikely that SNPs will have the expected effects on modifying eating habits and reducing rates of childhood overweight unless they are adhered to as intended.[14,17,29]

When SNP elements are not uniformly enforced throughout all school food environments, students may choose the less healthy options available at other venues (e.g., canteen or vending machine).[21,26,29] It has been found that beverage policies in American elementary schools have higher adherence rates than food policies, and different food environments (ie. canteen vs vending machine) within the same school also reported varying adherence rates.[14,21,22,29] Samuels et al.[19] stated that, because of

policy wording, schools with a beverage policy tended to have closer adherence than schools with a food policy. This may be due to the fact that beverage policy standards identified specific types of beverages that could be sold or banned, whereas food policy standards were nutrient-based and set specific nutrient limits for each item. It was recommended from these studies that creating categories of food items that are banned, similar to beverages categories, would provide more user-friendly guidance about what is healthy and allowed by the policy.[21] In regards to different levels of adherence in different school food environments, Cullen et al.[22] found that the sales of candy, chips, and soft drinks from the snack bar decreased, whereas vending machine sales of the same food items increased.

Most SNP studies have taken place in the United States[19-22,26,29] and either compared schools with and without a nutrition policy or the food environment before and after the adoption of a nutrition policy. Canadian nutrition policy studies [23,25,28,45-48] are beginning to increase in number, although very few have actually examined the effectiveness of SNP in changing eating habits or reducing obesity among children[23,26,45]. Further, caution must be used when comparing study findings among provinces since the guidelines and evaluation methods vary across the country.[17]

Significance of proposed study

PEI's SNP has the goals of improving dietary intakes of children and decreasing the rates of overweight and obesity.[44] Thus far, the SNAP research project has examined changes in the dietary behaviours of students in PEI since policy adoption[23,45.] The research described in this thesis is the first of its kind to identify whether the level of SNP adherence has any association with childhood overweight and obesity rates in

school, an indication that the policy is effective in reaching the goals.

My study is also the first Canadian study to examine both the principals' perceived adherence to policy elements, the percentage of 'allowed' food and beverage items available in all school food environments, as well as the agreement between both adherence measures from 2007 to 2010.

Since SNPs are complex and consist of a number of elements, it is essential to conduct a comprehensive assessment of adherence to the policy at the school level. The majority of previous studies have focused on food sales within the school. It is also important to assess the extent to which principals perceive their adherence to each policy element. Having the ability to compare perceived adherence to what is being implemented in the school can assist policy makers and researchers understand the nature of policy implementation process and identify possible areas where schools need support. PEI's SNP has guidelines for the food available in all three environments (lunch program, canteen, vending machines) so, in order for the policy to be effective, the guidelines must be adhered to in all of these environments. Since students may purchase 'not allowed' food and beverage items from various venues in school, it was also important to assess the food and beverage items available in all school environments.

Chapter 3: Nutrition Policy Adherence in Prince Edward Island Elementary Schools

3.1 Introduction

Childhood obesity rates have increased significantly over the past few decades in Canada and around the world.[1-8] Schools are being identified as an ideal environment to promote healthy eating and reverse the increasing rates of childhood obesity. Schools are considered an ideal environment because they have the unique ability to deliver positive health messages via health education and students consume, on average, one third of their daily food intake at school.[13,16,27,31,43] It has been found that the eating habits learned in childhood often carry over into adulthood, so healthy school-aged children are the key to a healthy population in the future.[9,12]

In recognition of the need to improve the diets and overall health of children, school nutrition policies (SNP) are being adopted in most Canadian provinces and territories, as well as in many other states and countries across the world.[13,30,43] Although the majority of Canadian provinces and territories have adopted SNPs, few have been evaluated. Evaluations of SNPs are needed to provide evidence for their effectiveness, identify barriers and enablers to successful implementation, and to reveal examples of best practices to assist in future development and growth of these policies.[17,18]

The majority of research evaluating SNPs is from the United States (US) and items offered in American cafeterias and lunch programs follow guidelines implemented under the National School Lunch Program (NSLP).[19-22,26,29] Canadian schools do not have guidelines similar to those of the NSLP and the policies tend to be developed

provincially with some implemented and monitored by individual districts or schools. There are currently a limited number of Canadian studies regarding SNPs.[23,25,28,45-48] These studies have either compared schools with and without a policy and/or examined the general level of policy implementation or the foods served as part of the NSLP. There appears to be less evidence regarding specific improvements to each school food environment.

One Canadian study, the School Nutrition and Activity Project (SNAP), was initiated in 2007 to assess the effectiveness of PEI's province-wide SNP by evaluating children's eating habits and body weight over a five-year period. As part of this study, Mullally and colleagues[23] found a decrease in elementary school children's intake of low nutrient dense foods (LNDF), an increase in milk and alternatives and an increase in vegetables and fruit one year after the SNP was introduced. However, Mullally's study[23] did not consider each school's level of policy adherence.

Also as part of the SNAP project, MacLellan et al[28] explored the complex process of evaluating SNP implementation using a mixed-methods approach with PEI elementary school principals in 2007. Results indicated that principals' perceived their adherence to the policy to be good overall with 87% of principals reporting that foods sold at their school were 'always' or 'mostly' consistent with the SNP. However, principals also indicated that they followed some elements of the policy more closely than others. Mullally's study[23] assessed food list adherence and compared the reported food and beverage items to policy guidelines to determine the percentage 'allowed'. It was found that 74% of all lunch items were considered 'allowed' by the SNP. To date, the changes in adherence to PEI's SNP over time have not been examined, nor has the

association with each policy element and the percentage of 'allowed' food. Evaluating the change in adherence over time will show the effectiveness of each element of policy and when it was most closely adhered to. Evaluating the adherence trends over time can also identify needed supports and if the SNP has varied in terms of being a priority for the school. It is important to examine the relationship between perceived and food list adherence to determine if principals' perceptions regarding policy implementation are similar to the extent that each policy element is being implemented. Assessing this relationship can also identify areas where support may be needed to most effectively implement the policy.

All PEI elementary schools adopted the SNP in 2006 so it was not possible to identify comparison schools that did not adopt the policy. Therefore, unlike previous studies[25,29] that have focused on comparing schools with a policy to those without, this study examined the food available in all school food environments (vending machines, canteen and lunch) in PEI elementary schools over time (in 2007 and 2010, one and four years after SNP adoption). It was important to examine all school food environments within each school because all environments have guidelines within the policy outlining the food and beverage items that are 'allowed'. It was also important to examine and compare adherence rates in each food environment since other studies[19,22,29,49] have found that adherence rates vary among environments within the same school. Previous studies[22,25] evaluated only the food available in lunch programs and did not include school canteens or vending machines. The food and beverage items in lunch programs are more likely to be studied because students consume the majority of food during lunch; further, not all schools have vending machines and/or canteens.[44]

Recent studies[30,40,49] have found that specific policy actions lead to significant changes in the school food environment, whereas the absence of a policy regulating food and beverages leads to no changes. All PEI schools have taken action and adopted a SNP; however, specific policy action in schools varies across the province[28]. The same SNP guidelines were implemented in every PEI elementary school in 2006 so this study was able to examine the environmental changes and levels of adherence in schools from 2007 to 2010.

The purpose of my research was to evaluate PEI's elementary schools' adherence to the SNP using both principals' self report (i.e., 'perceived adherence') and a more objective method (ie.'food list adherence') from 2007 (one year after implementation) to 2010 (four years after implementation). Principals' perceived adherence to all policy elements was assessed because each policy element contributes to improving dietary intakes in school (e.g. pricing strategies to encourage consumption of healthy items) and educating children about healthy behaviours (e.g. advertising to promote healthy options). If food list adherence was the only measure used to assess SNP adherence, the implementation of all other elements would not be measured. This is a concern, since each policy element has the potential to improve children's eating habits and overweight and obesity. This chapter also examined if principals' perceived adherence to policy elements had changed over time, or if adherence to any policy element was associated with higher food list adherence.

3.2 Methods

3.2.1 Design

This study was part of the SNAP Project, a five-year evaluation of the effect of SNPs on the eating habits and weight status of elementary school children on PEI. A cross sectional pre-post design was used to assess the level of adherence to PEI's SNP in 2007 and 2010. Ethical approval for this study was obtained from the University of Prince Edward Island Research Ethics Board (REB).

3.2.2 Instruments

Since this study involves secondary analysis of data collected in 2010 by Sparks[45] and the SNAP research team, data collection tools have already been developed or selected and used to collect the data as part of the overall SNAP project; details are described elsewhere[23,28]. The self-administered questionnaire to assess adherence was developed by the SNAP research team based on a review of the literature with questions adapted from instruments used in similar surveys in Manitoba, New Brunswick and Nova Scotia.[15,23,25,48] Once the instrument was developed, each item was reviewed for content validity and clarity. The completed questionnaire was then distributed to a school principal, a district principal and a manager of policy and planning from both school districts to review content and required time to complete. All suggestions or recommendations were then incorporated into the final version of the instrument.

The final version of the instrument (The Principal School Food Survey) (Appendix A) consisted of both subjective and objective components. The subjective component of the instrument assessed will be referred to in this thesis as "perceived

adherence"; the more objective component of the instrument assessed will be referred to as "food list adherence". The subjective component contained a 15-item scale assessing principals' perceptions of their degree of adherence to each policy element. In 2010, an additional item was added to assess whether there was a nutrition committee to oversee the school's healthy eating practices. The survey items had both dichotomous and ordinal responses. Questions 1-4 and 16 (asked in 2010 only) concerning the presence/absence of school food programs had dichotomous responses (no=1, yes=2). Questions 5-6 consisted of a 3-point ordinal scale (1=disagree, 2=agree, 3= strongly agree) that assessed the degree to which principals' felt they agreed that their pricing and food handling practices were in line with the policy guidelines. Questions 7-15 used a 4-point ordinal scale (1=never, 2=sometimes, 3=most of the time, 4=always) to assess the frequency with which principals were implementing nine specific policy elements (e.g. pricing foods to encourage consumption of healthy foods). The more objective component of the instrument consisted of checklists assessing the types of food and beverages offered in school vending machines and canteens and an open-ended question to determine specific details of foods offered as part of the school lunch program. The questionnaire also asked principals to report frequency and suppliers of offered lunch items.

3.2.3 Data Collection

Prior to data collection, approval to contact schools was obtained from each school district. Following an initial email introducing the study, a cover letter explaining the intent of the survey was faxed to each school along with a consent form and questionnaire. Principals were requested to return the completed questionnaire within

seven days by fax to the Department of Family and Nutritional Sciences (now Applied Human Sciences) at the University of Prince Edward Island. Schools that did not return their surveys by the seventh day were contacted by telephone and sent a new questionnaire if they required one. Schools were re-contacted when necessary to supply any information that may have been missing or unclear regarding food and beverage items offered. In an attempt to decrease the potential effect of social desirability bias[48], all principals were assured that their responses would not be identifiable by school board administration. Data were collected in the spring of 2007 and 2010.

3.2.4 Analysis

All data were entered using SAS-FSP and were checked for accuracy against the original questionnaire. SPSS, version 18 Chicago IL, was the software used for this study's analysis.

3.2.4.1 Perceived Adherence Assessment

Every response from the subjective portion of the Principal School Food Survey was coded so that closer adherence was assigned a higher scores (i.e never=0, sometimes=1, most often=3, always =4; disagree=0, agree=1, strongly agree=2). The perceived adherence score was then calculated by summing the ratings for each item on the Principal School Food Survey and dividing by the maximum score. The maximum perceived adherence score was dependent on the principals' answer to question 7 (if items sold in vending machines and/or canteens were from the 'Most Often' list). If principals reported that they had a canteen or vending machine their maximum perceived adherence score was 35. For those who reported 'not applicable to question 7

(i.e. that they did not have a canteen or vending machine) the maximum perceived adherence score they could achieve was 32. Question 16, which assessed whether schools had a designated nutrition committee, was not included when calculating the perceived adherence score because the question was added to the survey in 2010. The calculated perceived adherence scores were expressed as a percentage and placed into one of the following four categories to facilitate the interpretation of the results: 0-25% adherence, 26-50% adherence, 51-75% adherence and 76-100% adherence.

3.2.4.2 Food List Adherence Assessment

All schools in PEI offer and have food available to students to some degree; however, the frequency of the lunch program varies among schools and not all schools offer items from a vending machine or a canteen. Principals were asked to report the items offered in the lunch program, vending machines and canteens. For the lunch program, principals were also asked to report on the frequency, brand and any specific details of each item. The food and beverage items reported on the Principal School Food Survey were then compared to policy guidelines by a dietitian to determine if the item was 'allowed' or 'not allowed' by the policy. PEI's SNP guidelines include three food lists specifying food types and frequency of consumption. Foods from the 'Food to Serve Most Often" list are 'allowed' daily and include nutrient dense foods identified by Eating Well with Canada's Food Guide.[51] These foods are also low in fat and sugar. Foods from the 'Food to Serve Sometimes' list are 'allowed' two to three times a week.[44] Foods from this list contain essential nutrients but are higher in fat and sugar. Foods in the 'Food to Serve Least Often' list are 'allowed' one to two times a month. These foods are low in nutrients and high in sugar, fat and/or sodium. An individual

food or beverage was considered 'allowed' if it was included in the 'Most Often' list, or if it was included in the 'Sometimes' or 'Least Often' list, and the sum of the frequency of all foods in these two categories did not exceed the maximum frequency permitted on a monthly basis. The food list adherence score for each environment was then calculated by summing the number of 'allowed' items in a specific environment and dividing by the total number of items offered in that environment.

Descriptive statistics were generated for the principals' perceived and food list adherence score (mean, mode, standard deviation) and the adherence categories (frequencies). The proportion of 'allowed' foods for a school's food environment (lunch, canteen, vending machine) was calculated by dividing the total number of 'allowed' foods available in the specific school food environment by the total number of foods offered in that environment. The proportion of 'allowed' foods for the entire school food environment was calculated by dividing the total number of 'allowed' foods available at school by the total number of foods offered in all school food environments (vending, canteen and lunch).

The Wilcoxon-rank sum test was used to assess differences in perceived adherence scores from 2007 to 2010. Chi-square analysis of association was used to determine if there was an association with food list adherence in each school food environment (% allowed foods offered in lunch, vending machine and canteen) and all food in the school environment (total allowed foods/all foods offered in all three environments) one and four years after SNP adoption. Spearman's rho was used to determine if there was a significant association between principals' perceived adherence to policy elements and food list adherence.

3.3 Results

3.3.1 Sample Description

All elementary (Grades 1-6) and consolidated (Grades 1-8) schools in the English Eastern School District (ESD) and Western School Board (WSB) of Prince Edward Island were invited to participate in this study. In 2007, 41 of 44 schools participated resulting in a response rate of 93%. There were fewer (37) elementary and consolidated schools in 2010 due to the school closures in 2009; 35 of these participated resulting in a 95% response rate. There were eight schools that participated in 2007 that did not participate in 2010 due to seven school closures during the survey time period. There were also two schools that participated in 2010 that did not participate in 2007. Due to school closures and relocation of principals, the principal completing the survey may have changed over the time period, although the number is unknown.

3.3.2 Principals' Perceived Adherence to Policy Components

The frequency distributions of positive responses ('yes', 'agree', 'strongly agree', 'most of the time', 'always') for each policy element in 2007 and 2010 are shown in Figures 1 and 2. Most principals reported that they allowed at least 20 minutes to eat lunch, had a stocked emergency cupboard, participated in the provincial school milk program, and offered a breakfast program at school. Almost all principals reported that they 'agree' or 'strongly agree' to pricing healthy foods lower than unhealthy food to encourage consumption (97%), safe food handling practices (99% in 2007, 92% in 2010), promoting only healthy food choices, and advertising at school (88% in 2007, 100% in 2010). In both time periods, most principals reported that they participate in nutrition activities with the Healthy Eating Alliance (HEA) (77% in 2007, 88% in 2010)

and used non-food items for rewards (87% in 2007, 97% in 2010). Approximately one third of principals reported that their staff participated in professional development in both 2007 (32%) and 2010 (35%). There was a increase from 87% in 2007 to 97% in 2010 of principals reporting that the food available was consistent with the SNP 'mostly' and 'always' provided food from 'most often' or 'sometimes' list, staff acting as role models, and fundraising emphasizing non-food or healthy products.

Figure 1 *Proportion of Principals' Reporting Adherence to School Nutrition Policy Elements in 2007 (n= 41) vs 2010 (n=35)*

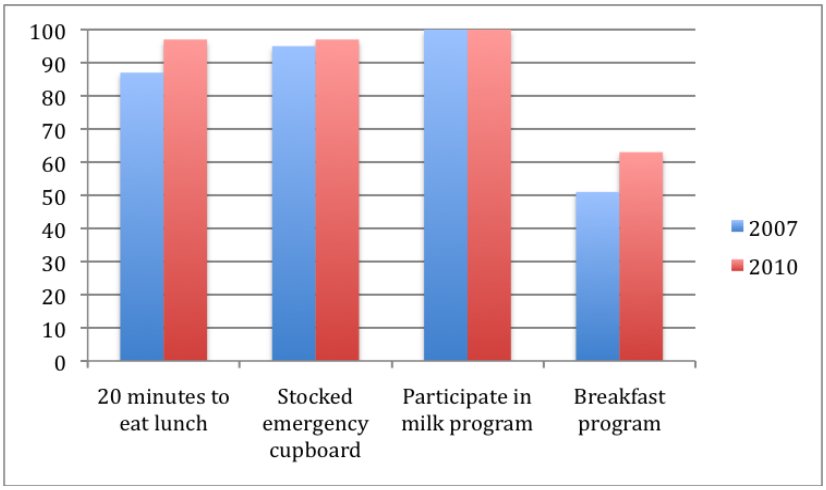
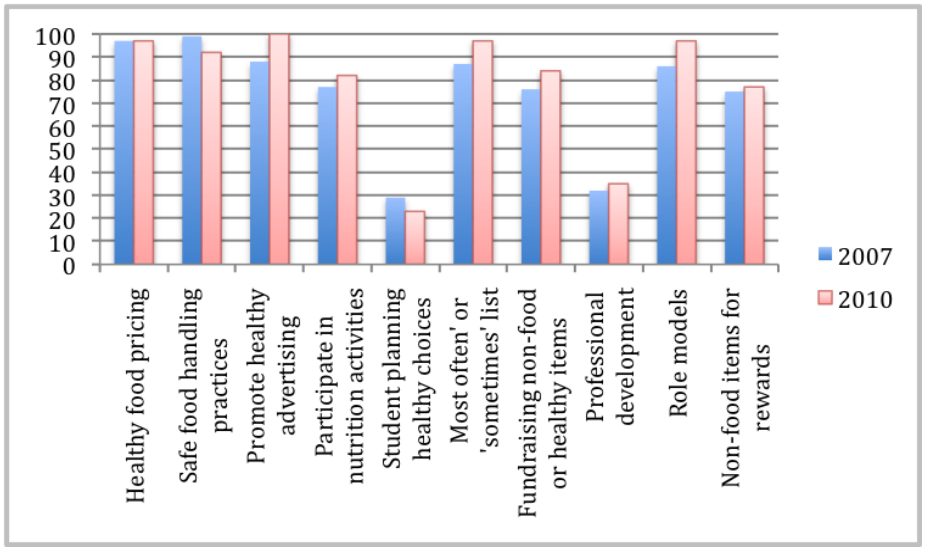


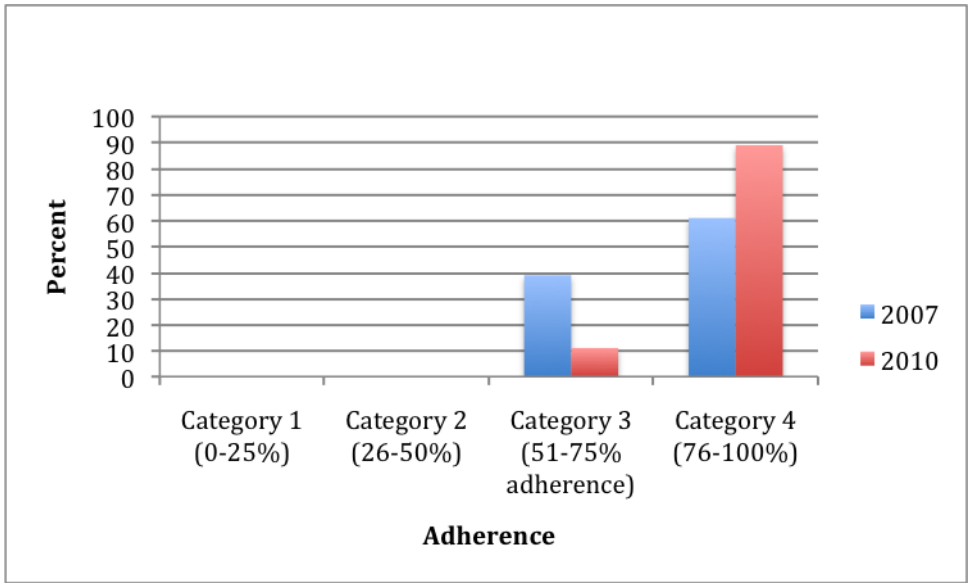
Figure 2 *Proportion of Principals' Reporting Adherence to School Nutrition Policy Elements In 2007(n= 41) vs 2010 (n=35)*



3.3.1.2 Overall Perceived Adherence Score and the Changes from 2007-2010

Figure 3 shows the distribution of the perceived adherence score categories for both 2007 and 2010. All schools in both 2007 and 2010 had a perceived adherence score greater than 51%. In 2007, the average perceived adherence score was 79%; this increased slightly to 82% in 2010. The Wilcoxon-rank sum test was used to measure the differences in principals' perceived adherence scores one and four years after policy adoption. The mean rank of perceived adherence in 2007 was 33.7 and 44.2 in 2010; the perceived adherence scores differed significantly between 2007 and 2010 (Mann-Whitney U= 519.5, p =0.007).

Figure 3 Principals' Perceived Adherence Scores By Category in 2007 (n=41) vs 2010 (n=35)

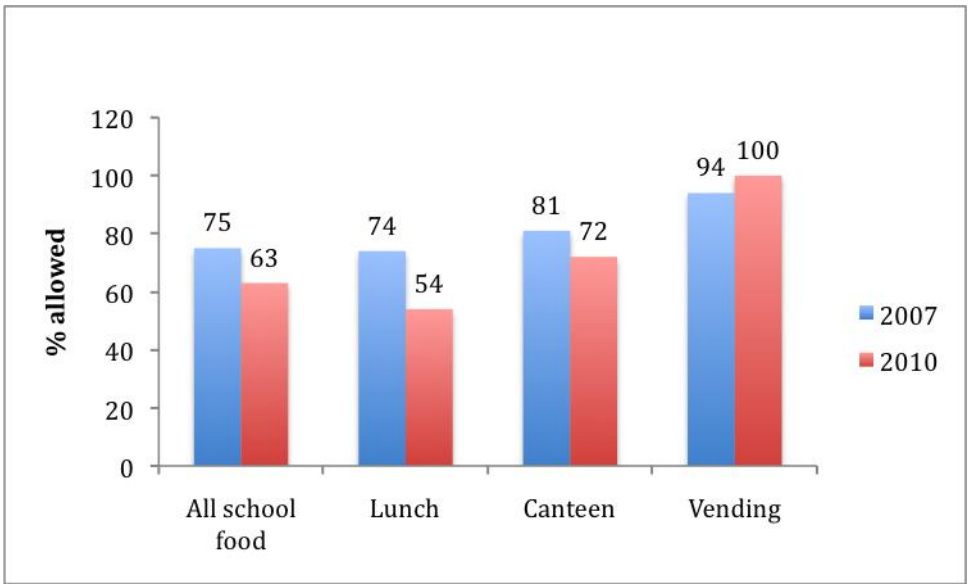


3.3.3 Food List Adherence

A key component of PEI's SNP is the guidelines for 'allowed' food and

beverages items. Figure 4 shows the changes in the percentage of 'allowed' food offered in each school food environment in 2007 and 2010.

Figure 4 Food List Adherence Scores by School Food Environment in 2007 (n=41) vs 2010 (n=35)



3.3.3.1 All School Food

In Prince Edward Island, the average proportion of all 'allowed' food and beverage items in all school food environments (lunch, canteen and vending machines) decreased from 75% in 2007 to 63% in 2010.

3.3.3.2 Lunch Program

All schools in 2007 and 2010 offered a lunch program, which varied in frequency (number of times a month a lunch program was offered) and in the food and beverage items offered. This study found a decrease in the percentage of 'allowed' lunch program items offered from 74% in 2007 to 54% in 2010 (Figure 4). There was a change

in the most common ‘allowed’ food and beverage items being offered at school in 2007 and 2010. According to principals’ self report, potatoes (49%) and pizza with processed meats (37%) were the most frequently reported ‘allowed’ food items offered according to policy guidelines (either based on nutrient criteria or frequency of offering) in 2007, while cheese pizza (34%) and subs (31%) were the most frequently reported ‘allowed’ items in 2010 (Table 1).

Pizza with processed meats and regular (deep fried, then frozen and reheated) chicken nuggets were the most frequently reported ‘not allowed’ items in both 2007 and 2010. The number of schools serving these ‘not allowed’ items increased significantly over time. In 2007, these items accounted for 27% and 24% of all items offered, compared to 49% and 43% of offerings in 2010 (Table 2).

3.3.3.3 Canteen

In 2007, 24 (58%) schools reported having food available in a school canteen and 20 (57%) schools reported having a school canteen in 2010. The average percentage of ‘allowed’ food in school canteens was 81% in 2007; this decreased to 72% in 2010 (Figure 3). The most common ‘allowed’ items in 2007 and 2010 were white milk, chocolate milk and yogurt (Table 1). Cookies and ice cream were the most common ‘not allowed’ items in both years (Table 2). While canteen items ‘allowed’ by the policy were similar in both years, they were served on a more frequent basis in 2007 compared to 2010. The number of ‘not allowed’ canteen items was also similar between the two time periods; however, the proportion of cookies and chips being offered doubled from 2007 to 2010.

3.3.3.4 Vending

In 2007, sixteen (39%) schools had items available in vending machines compared to eight (23%) schools in 2010. The percentage of 'allowed' vending machine items improved from 94% in 2007 to 100% 2010 (Figure 3). Fruit juice was the most common 'allowed' vending machine item in 2007 and 2010. Water was the second most frequent 'allowed' item in 2007 (32% of offerings); this decreased to only 3% of offerings in 2010 (Table 1). Fruit juices and fruit drinks were the most common 'not allowed' vending items in 2007 but only accounted for 2% of vending machine offerings; there were no 'not allowed' vending items in 2010 (Table 2). Fruit juice could be classified as an 'allowed' or a 'not allowed' item depending on the fruit content since fruit juice containing less than 100% real fruit juice is listed on the 'Least Often' list. Items on this list would be considered 'allowed' if no more than 2 items are served each month. If fruit juice with less than 100% real fruit was served along with 2 other items from this list, or more than twice in one month, it would be considered 'not allowed' according to policy guidelines.

Table 1Most Common Food and Beverages 'Allowed' by the School Nutrition Policy based on the Percentage of School Offerings in 2007 (n=41) vs 2010 (n=35) by School Food Environment

Environment	2007 Item	2007%	2010 Item	2010%
Lunch	Potatoes	48.8	Cheese pizza	34.3
	Meat pizza	36.6	Subs	31.4
	Vegetable & fruit	24.4	Potatoes	28.6
	Spaghetti	19.5	Regular hot dog	20.0
	Regular hot dog	19.5	Spaghetti	17.1
Canteen	White milk	53.7	White milk	48.6
	Chocolate milk	53.7	Chocolate milk	48.6
	Yogurt	17.1	Yogurt	28.6
	Cheese & cracker	14.6	Fruit juice	25.7
	Granola bar	12.2	Fruit	22.9
Vending	Fruit juice	34.1	Fruit juice	22.9
	Water	31.7	White milk	8.6
	Fruit	7.3	Chocolate milk	8.6
			Water	3

Table 2Most Common Food and Beverages 'Not Allowed' by the School Nutrition Policy based on the Percentage of School Offerings in 2007 (n=41) vs 2010 (n=35) by School Food Environment

Environment	2007 Item	2007%	2010 Item	2010%
Lunch	Meat pizza	26.8	Regular chicken nuggets	48.6
	Regular chicken nuggets	24.4	Meat pizza	42.9
	Regular hot dog	17.1	Wraps	5.7
	Subs	14.6	Potatoes	5.7
	Ice cream	9.8		
Canteen	Ice cream	31.7	Ice cream	34.3
	Cookie	4.9	Cookie	11.4
			Regular chips	11.4
			Cheese and crackers	8.6
Vending	Fruit drink	2.4	No items	0
	Fruit juice	2.4		

PEI schools served a lower percentage of 'allowed' food and beverage items in the lunch program and in canteens in 2010 compared to 2007. However, the percentage of vending machine items increased from 2007 to 2010. The chi-square test was used to determine if there were statistically significant changes in the percentage of 'allowed' food and beverage items from 2007 to 2010. As shown in Table 3, the percentage of 'allowed' lunch items decreased significantly from 2007 to 2010 (x^2= 12.576, df=3, p=0.006). The proportion of 'allowed' vending machine items increased significantly from 2007 to 2010 (x^2=13.689, df=1, p=0.008). However, there were no statistically significant changes in the percentage of 'allowed' items sold in school canteens or the overall proportion of 'allowed' items in the total school food environment from 2007 to 2010.

Table 3 Changes in the Proportion of 'Allowed' Food and Beverage Offerings According to School Nutrition Policy Guidelines in 2007 (n=41) vs 2010 (n=35)

	2007 Mean±SD	2010 Mean±SD	X^2	df
% 'Allowed' Lunch	73.7±24.3	54.0±34.8	12.6	3
% 'Allowed' Vending	93.8±17.1	100±0.	13.7	1
% 'Allowed' Canteen	81.2±22.4	72.1±22.1	4.72	2
% 'Allowed' All environments	75.4±20.4	63.1±24.9	5.97	3

3.3.3 Relationship Between Perceived and Food List Adherence

Results indicated that, overall, principals perceived their adherence to the policy to be improving from 2007 to 2010, while the level of food list adherence has decreased during the same time period. The results from Spearman's rho test indicated that there was no significant relationship with the perceived policy adherence score and the food list adherence score. Table 4 shows the relationship between perceived adherence and food list adherence of lunch program items by year and by policy element. In 2007, the relationship between the perceived adherence score and the food list adherence score for lunch program items was positive and significant with three policy elements (pricing of healthy food to encourage consumption, promotion of healthy food, and foods served from the 'most often' list). This analysis found a positive relationship between principals' perceived adherence to pricing of healthy foods and food list adherence. Principals who reported pricing food to encourage consumption of healthy items offered a higher percentage of 'allowed' lunch items (correlation= 0.342, p=0.033) at their school. Principals who reported promoting healthy food at school reported a higher proportion of 'allowed' lunch items (correlation=0.352, p=0.026). Also in 2007, principals who reported frequently serving food from the 'Most Often' or 'Sometimes' lists actually reported a higher percentage of 'allowed' lunch items (correlation= 0.390, p=0.017). In 2010, principals who reported the presence of a nutrition committee also reported a higher percentage of 'allowed' lunch items (correlation= 0.310, p=0.075).

Table 4 Relationship Between Perceived Adherence and Proportion of 'Allowed' Lunch Items According to Policy Guidelines in 2007 (n=41) vs 2010 (n=35)

Policy element	**2007**		**2010**	
	Correlation coefficient	**p**	**Correlation coefficient**	**p**
20 minutes to eat lunch	-0.246	0.127	-0.238	0.175
Stocked emergency cupboard	0.228	0.163	0.058	0.750
Healthy food pricing	0.342	0.033	0.005	0.977
Safe food handling practices	-0.016	0.922	-0.141	0.426
Promote healthy advertising	0.352	0.026	0.168	0.342
Participate in nutrition activities	0.071	0.674	-0.023	0.895
Student planning healthy choices	-0.056	0.732	0.213	0.226
Foods from most often or sometimes list	0.390	0.017	0.046	0.797
Professional development	-0.206	0.208	-0.011	0.952
Role models	0.165	0.310	-0.078	0.668
Nutrition committee	*		0.310	0.075

* Question not asked on 2007 survey

3.4 Discussion

This is the first Canadian study to assess the level of adherence to a school nutrition policy over time using two different measures: a self reported perceived measure to assess adherence to all policy elements and a more objective measure of adherence to foods 'allowed' and 'not allowed' by the policy. While the limited research to date contains aspects of my study (e.g. assessing the food available in the lunch program) no study, to my knowledge, has looked at the changes in perceived and food list adherence over time or assessed the relationship between these two measures of

adherence.

The observed increase in perceived adherence from 2007 to 2010 was in the expected direction. PEI principals reported that they followed the policy guidelines most of the time with the majority of principals reporting Category 4 adherence (greater than 76%). Even though most principals perceived good adherence overall, some indicated that they 'never' implemented certain policy elements. In contrast, the observed decrease in food list adherence (number of food items meeting guidelines as a % of total food items served) over the same time period in the lunch program and in school canteens was not in the expected direction. Unlike the lunch program and school canteens, vending machine food list adherence increased over time. In both 2007 and 2010, the beverages sold in PEI school vending machines were the most consistent with SNP guidelines and items from the lunch program were least consistent with the SNP guidelines. In contrast, Samuels et al[19] found that the items served in Pennsylvania school lunch programs were more consistent with SNP guidelines compared to items offered in all other school food environment. An explanation for the contrast in findings could be that the study highlighted was American where a national, government-implemented lunch program is in place with very strict guidelines and the policies regulating food items in other school food environments are not adhered to as strongly. Another reason for high vending machine adherence in my study could be that vending machines in PEI only offer beverages. Previous studies[19-21,29] have found that beverage policy adherence tends to be higher than food policy adherence because beverage policies tend to indicate which specific beverages are 'allowed' or 'not allowed', while food policies are nutrient based. Nutrient-based policy criteria can be confusing for

school principals, staff and volunteers since they are unlikely to have nutrition training; it may be easier to have a list of specific 'allowed' and 'not allowed' items. Such Brand Name Food Lists (e.g. www.brandnamefoodlist.ca) are currently being used in several Canadian provinces, although their effectiveness in improving school adherence to SNPs has not yet been formally evaluated. PEI schools also made changes to vending machines early on in policy development so principals may have been more aware of what is 'allowed' to be served in vending machines compared to canteens or the lunch program.

The study found that perceived adherence increased over time and food list adherence decreased during the same time period. This finding suggests that principals may be facing some barriers when it comes to implementing SNP elements or principals may be unaware that they are not implementing elements the way they were intended. At first glance, the increase in perceived adherence could reflect an increased knowledge and familiarity of policy guidelines over time. However, the decrease in food list adherence in the same time period indicates that the SNP guidelines are not being implemented as closely as they were in 2007 or as closely as principals reported. It was important to assess the relationship between both measures of adherence to see if principals' perceptions were in line with how the SNP was being carried out in the school. There were no significant associations with the overall perceived adherence score and the food list adherence score for each environment in both years. There were, however, three moderate, positive correlations between the level of perceived adherence to policy elements (pricing to encourage consumption of healthy items, promoting healthy advertising, and serving from the 'most often' list) and the percentage of

'allowed' lunch items in 2007. The positive significant correlation between the percentage of 'allowed' lunch items and principals reporting that they frequently served food from the 'Most Often' list suggests that principals who subjectively reported higher adherence were, in fact, following the policy according to their food list adherence score. The principals who subjectively reported serving 'allowed' items 'sometimes' or 'never' had lower levels of food list adherence in their schools. The positive correlation between food list adherence and the policy elements pertaining to pricing strategies and healthy advertising suggest that these principals are trying to implement the policy the way it was intended to increase students' awareness of and access to healthy options. While it is important to have the healthy options available at school, they also need to be priced accordingly and promoted in schools so that children are apt to choose the healthy option over the unhealthy option.

The only significant policy element that was correlated with the level of food list adherence in 2010 was the presence of the nutrition committee: schools with a nutrition committee in 2010 had higher food list adherence rates than schools that did not have a nutrition committee. Although few PEI schools have a formal nutrition policy committee, other Canadian studies[47,48] suggest that have such a group has a positive effect on potential food sales.

While my study did not aim to assess the validity of the methods used to assess adherence, it does show how important it is to consider all elements of the policy when evaluating adherence. If only perceived adherence was evaluated, it would have given the impression that schools were doing well while evaluating only food list adherence would have suggested that schools were struggling to follow the policy. Examining both

measures of adherence and assessing the relationship between the two showed that the perceptions of some principals' match their reports of foods and beverages offered at school. Principals whose perceived adherence was not consistent with their food list adherence may be unaware of policy guidelines or be unaware on how to implement them effectively. These principals may also have over-reported their level of adherence to each element due to social desirability bias and wanting to be portrayed as successfully implementing the policy. The decline in food list adherence and the increase in perceived adherence over the same time period indicate that SNP adherence may be dependent on a number of factors.

The level of SNP adherence is dependent on a number of factors and can increase over time as schools become more familiar or knowledgeable about the guidelines or it can decrease over time due to fatigue, lack of interest or decreased priority for schools.[32] The variation in the relationship between perceived adherence and food list adherence showed that the resources or supports needed to improve SNP adherence will differ for each school and be dependent on the barriers they face. Principals who had high perceived adherence scores and low food list adherence scores may find policy education a valuable resource as they are unaware on how to effectively implement the guidelines. However, principals who reported a high level of perceived adherence because of social desirability bias may not benefit as much from increased education if they are truly aware that they did not adhere to the elements to the extent they reported. These principals could benefit from stronger direction from the school district regarding the importance of following a policy and the outcomes it can have on student health. Principals who had perceived adherence scores that were consistent with

their food list adherence (e.g. high perceived adherence and high food list adherence, or low perceived adherence and low food list adherence) may also not benefit from increased education as they were aware of how they implemented each element as the outcome in the school (% food 'allowed) was consistent with their self-reports. Further research which uses a mixed methods approach[23], may help explain why some principals are still not offering food from the 'Most Often' or 'Sometimes' category four years after policy adoptions and what supports would best assist them. One of the barriers facing PEI principals identified by MacLellan[28] was that nutrition policies are not a priority for many schools. It was also reported that resistance to change, lack of resources and profit losses from offering healthy foods and beverages at school are all barriers to policy adoption.[28,52] For the SNP to be successful at improving dietary intake and decreasing childhood overweight and obesity, it is important to provide targeted support to all schools, as the benefits of the policy will only be seen if the policy is implemented as it was intended.

In conclusion, this chapter highlighted the importance of assessing adherence in all school food environments as well as adherence to all other policy elements. The observed decline in food list adherence over time suggests that PEI schools may be struggling with the guidelines or the SNP may not be a priority relative to other competing demands on schools. The supports needed to alleviate the barriers contributing to low SNP adherence should be specific to each school's need. Some of the schools with low food list adherence had reported low perceived adherence while others reported very strong perceived adherence. As mentioned previously, the policy goals cannot be achieved unless all elements are effectively implemented the way they

were intended. In order to determine if the policy is successful, it is also critical to examine the impact that the SNP has on student overweight and obesity rates. Chapter 4 will address the relationship between school nutrition policy adherence and overweight and obesity rates in grade five and six students.

Chapter 4: Nutrition policy adherence and overweight and obesity rates among grade five and six children in PEI

4.1 Introduction

The concern over childhood obesity has increased due to the increasing prevalence rates in a short amount of time, the associated medical consequences, and the risk for obesity carrying over into adulthood.[1,10-12] The two main contributors to childhood obesity are diet and physical activity including an increased consumption of food and beverages that are high in fat, sugar and calories and a decreased amount of physical activity.[1,10-12] Social factors, such as income and education, have also been associated with obesity, but those factors also tend to also be associated with food consumption and physical activity.[1,10] School nutrition policies have therefore focused on improving children's dietary intakes and physical activity to prevent and decrease children's overweight and obesity rates. Schools are becoming a popular environment for the implementation of these policies because of their ability to target a large number of children across socio-economic levels and to facilitate nutrition education.[13,31]

School Nutrition Policies (SNPs) have been adopted in most Canadian provinces and territories. Although specific policy content tends to vary among provinces, the focus of the majority of Canadian SNPs is limiting or banning foods that are high in fat, sugar, and sodium, banning sweetened beverages, increasing physical activity, and increasing children's nutrition knowledge. The support and mandate of SNPs across the country varies, and they may be executed and monitored at the provincial, school or district level. The literature is limited on the level of SNP adherence in Canada, and any positive impacts of following these policies such as an improvement in children's'

overweight and obesity rates. The literature available, which is mostly from the United States, indicates that schools have varying adherence rates among school food environments (lunch, canteen, and vending machine) and that beverage guidelines are more strongly adhered to than food guidelines. However, none of these studies have examined the relationship between adherence levels and overweight and obesity rates.[20-22,29]

A few Canadian[25,53] and U.S. studies[,30,39,52] have examined the impact of a SNP on the prevalence of overweight and obesity in children. The studies examining the impact of SNP on overweight and obesity used policy adoption as their independent variable and did not directly assess the level of adherence. The limitation with using policy adoption as the independent variable is that it is dichotomous and does not convey evidence to how well the policy is being implemented. The results of these studies have varied and may be due to an insufficient 'dose' (extent of implementation) of the intervention,[25,30] barriers to effective implementation,[28,52] inability to effectively target high-risk children or the behaviours targeted in school not being directly relating to body weight.[39] Even though the findings and strength of findings varied in previous studies, it appears that the majority of studies regarding the presence of a SNP have a positive effect on children's weight status. Several reviews [17,18,30] have recommended examining the level policy adherence on children's overweight and obesity in order to determine the specific impact that SNPs have and if they are effective.

The specific objective of this chapter is to assess the relationship between the level of SNP adherence and weight status of grade five and six students in PEI. It was hypothesized that schools with higher levels of adherence would have lower rates of

overweight and obesity.

4.2 Methods

4.2.1 Design

This study was part of the School Nutrition and Physical Activity (SNAP) project, a five-year evaluation of the effect of SNPs on the eating habits and weight status of elementary school children on PEI. A cross-sectional design was used to assess the level of adherence to SNPs in PEI elementary schools in 2010. A self-administered questionnaire containing both objective and subjective sections was used to evaluate policy adherence in the spring of 2010.[28] The actual heights and weights of grade five and six students were also assessed to determine the prevalence of overweight and obesity in each school for this age group. Ethical approval for this study was obtained from the University of Prince Edward Island Research Ethics Board.

4.2.2 Sample

Grade five and six students from a total of 37 schools participated in this study in 2010. Out of 2834 grade five and six students, 1645 had parental consent to participate in this study, representing a 61% response rate. However, after accounting for absent or sick children on the day of the survey, the participation rate was 58%.

4.2.3 Assessment of Adherence

Adherence to SNP guidelines was assessed using the Principal School Food Survey (Appendix A). The survey was faxed to principals within one week of an introductory letter explaining the intent of the survey. Principals were contacted to provide additional information or clarification when needed. SNP adherence was assessed using two measures: perceived (subjective) and food list (more objective).

Perceived adherence scores were calculated using the responses from the Principal School Food Survey, which assessed principals' perceptions about their level of implementation of policy elements. Details regarding the development of the questionnaire was described in Chapter 3 of this thesis as well as in previous studies evaluating PEI's SNP.[54] All responses from the Principal School Food Survey were scored with higher adherence to each element resulting in a higher score (i.e. disagree=0, strongly agree=2). To calculate an overall perceived adherence score, all responses were summed and divided by the maximum score. The maximum perceived adherence score was dependent on the principal's answer to question 7 (items sold in vending machines and/or canteens). If principals reported that they had a canteen or vending machine their maximum perceived adherence score was 35. For those who reported that they did not have a canteen or vending machine, the maximum perceived adherence score they could achieve was 32.[28] The calculated perceived adherence scores were than recoded to create four categories of adherence for the facilitation of results; 0-25% adherence, 26-50% adherence, 51-75% adherence, 76-100% adherence.

Food list adherence was calculated by comparing the reported food available at school to policy guidelines to determine if each item was categorized as 'allowed' or 'not allowed'. The food list score was then determined by dividing the number of 'allowed' foods offered in each environment by all items offered in each environment (lunch, vending machine, and canteen).

4.2.4 Assessment of Heights and Weights

Children's heights and weights were measured to calculate BMIs[29] and to assess the prevalence of overweight and obesity. Measured heights and weights were used

since they have been shown to be more accurate than self-reported or parent-reported data.[44] All measurements were conducted in a private area or an area with privacy boards so children's results would remain confidential. Trained research assistants, which included senior undergraduate nutrition students, supervised by dietitian researchers, used standard procedures to collect the height and weight measurements of all grade five and six students who had parental permission to participate. Depending on the size of the school, the number of trained research assistants collecting the data ranged from four to eight and a dietitian supervisor.

Standing height was measured using a standard wooden stadiometer to the nearest 0.01 cm after students removed their shoes. Height measures were repeated at least twice and a third time if there was a discrepancy (>0.3 cm) between the first two measures. The average of the two closest measures was calculated as the final height. Students were weighed to the nearest 0.01 kg using calibrated remote display digital scales. Overweight and obesity were defined using international BMI cut-off points adjusted to specific age and sex categories for children.[34]

4.2.4 Assessment of factors associated with overweight and obesity

A number of co-variates were included because they have been found to be possible contributing factors to childhood overweight and obesity.[10] Physical activity, screen time, frequency of breakfast consumption, fruit and vegetable consumption, low-nutrient density food (LNDF) consumption, parental income, parental education, student grade, and student sex were included as predictor variables in both regression models.

All participating students completed a questionnaire assessing their dietary

intakes, physical activity levels and socio-demographic characteristics. The approximate level of physical activity in the last year was assessed using a 4-point ordinal scale (never, less than once a week, 1-3 times a week, 4 or more times a week). The frequency of breakfast consumption was assessed using a 5-point ordinal scale (never, rarely, weekends only, sometimes, everyday). For the purpose of this analysis, students were considered breakfast consumers (everyday) or breakfast skippers (sometimes, weekends only, rarely, never). Screen time was measured by assessing the frequency of television and computer use in the last week. Both of these variables were assessed using a 5-point ordinal scale (less than 1 hour a day, 1-2 hours a day, 3-4 hours a day, 5-6 hours a day, 7 or more hours a day). Students' dietary intakes were measured using the Eating Behaviour Survey (EBS). The EBS is a food frequency questionnaire that includes 27 foods. The food list was developed and validated as part of an Ontario child health study using a food group analysis of 24 hour recalls.[23] Trained research assistants were present during the data collection to assist children with recall and understanding of the food groups. The food frequency questionnaire was used to assess children's total daily intakes of milk and alternatives, vegetables and fruit and low nutrient dense foods (LNDFs).[55] LNDFs include French fries, cakes, snacks, candy, and soft drinks. For the purpose of this analysis, consumption of three or more of these foods daily was used as a cut-off to identify students with high consumption levels; this was used in previous survey of PEI school children used by Mullally and colleagues[23] and is based on the distribution of the data and the notion that levels higher than this would likely displace healthy food choices.[54]

All parents were asked to complete a questionnaire and the data collected was

used to assess income and education levels. Parental income and education levels can impact a child's risk of becoming overweight or obese[11] so it was very important for these to be included in the model. Both of these variables were categorical and ranked on a 5 point scale.

4.2.5 Analysis

Logistic regression analysis was used to examine the relationship between the level of SNP adherence and overweight and obesity rates. The dependent variable (weight status) was based on the cut-offs recommended by Cole et al[34] (e.g. overweight and obese). The level of SNP adherence was the independent variable; however, four adherence variables (food list lunch, food list vending, food list canteen, perceived adherence) were included to represent the entire school food environment.

Multivariate logistic regression was selected because it is appropriate when predicting the outcome of a categorical variable based on one or more co-variate.[56] A backward stepwise procedure was used, which began with all variables included. Variables were then eliminated from each model if $p > 0.20$. This procedure was run in a two-step process: 1) all possible co-variates were included in the model, and 2) all other variables with $p > 0.20$ were removed from the model because of the low probability that they were important predictors of the dependent variable. Two sets of models (one with overweight and one with obese as dependent variables) were built using the two measures of adherence (perceived and food list) as independent variables and including the other co-variates.

4.3 Results

Frequency distributions for all co-variates can be found in Appendix E.

Presented below are the models predicting children's overweight and obese rates for both measures of adherence (perceived, food list).

4.3.1 Regression Model Containing Perceived Policy Adherence, Lunch Adherence, Canteen Adherence, and Total School Food Adherence as Determinants of the Overweight Status of Grade Five and Six Children

Table 5 shows the best model for predicting overweight, with adherence as the main independent variable. All four measures of adherence (perceived, food list lunch, food list vending, food list canteen) were included. Perceived adherence and food list adherence of lunch items were the only measures of adherence that were significant predictors of overweight. Perceived adherence was a significant predictor ($p = 0.020$). The positive coefficient indicated that schools with higher levels of perceived adherence were 2.3% more likely to have overweight students. Food list adherence for lunch items was also a significant predictor ($p = 0.022$) of overweight. The negative coefficient indicated that schools with a higher food list adherence for lunch items were 0.5% less likely to have overweight students compared to schools with a lower food list adherence for lunch items.

Table 5 Concepts Associated with the Overweight Rates of Grade Five and Six Students: Summary of Logistic Regression Analysis

Model	**Cox and Snell**	**Nagelkerke**	**Log**	**95% Confidence Interval**	
	0.044	0.061	1673	Lower	Upper
Concept	**Beta**	**Sig.**	**Odds Ratio**		
Perceived adherence[1]	0.023	0.020	1.023	1.004	1.043
Food list lunch[2]	-0.004	0.022	0.996	0.992	0.999
Physical Activity No Coach[3]	-0.175	0.030	0.840	0.717	0.983
Breakfast[4]	-0.282	0.001	0.754	0.647	0.873
LNDF Consumption[5]	0.314	0.044	1.369	0.859	0.998
Sex[6]	-0.295	0.013	0.745	0.597	0.949
Education[7]	-0.278	0.000	0.757	0.666	0.850

[1]Calculated perceived adherence score based on Principal School Food Survey; [2]Percent 'allowed lunch items; [3]Physical activity without a coach frequency in the last year; [4]Student reported breakfast frequency; [5] LNDF consumption; [6]Student sex; [7]Parent education

Physical activity without a coach was a significant (p = 0.03) predictor of children's overweight status. The negative coefficient indicated that students who participate in more frequent physical activity were 16% less likely to be overweight. Breakfast frequency was also a significant (p = 0.001) predictor of overweight, indicating that students who consumed breakfast were 24.6% less likely to be overweight compared to breakfast skippers. LNDF consumption was a significant (p = 0.044) predictor of overweight, indicating that those who ate more than three daily servings (high consumption) of LNDFs were 36.9% more likely to be overweight. Based on the model, boys were 25.5% more likely to be overweight than girls. This finding is consistent with the raw data indicating that boys had higher overweight rates than girls. Students whose parents reported higher levels of education were 24.3% less likely to be overweight.

4.3.2 Regression Model Containing Perceived Policy Adherence, Lunch Adherence, Canteen Adherence, and Total School Food Adherence as Determinants of Obesity Status of Grade Five and Six Children

Table 6 displays the model for predicting obesity after removing the non-significant variables. Unlike the model for predicting overweight, no measure of adherence was a statistically significant predictor of obesity. Food list adherence was not removed from the model, as the p-value was less than 0.2. However, the relationship was in the same direction as the overweight model, with schools adhering more closely to the SNP being less likely to have obese students than schools adhering less closely to the policy.

Table 6 Concepts Associated with the Obesity Rates of Grade Five and Six Students: Summary of Logistic Regression Analysis

Model	**Cox and Snell**	**Nagelkerke**	**Log**	**95% Confidence Interval**	
	0.036	0.070	898	Lower	Upper
Concept	**Beta**	**Sig.**	**Exp (B)**		
Food list lunch[1]	-0.004	0.120	0.996	0.991	1.001
Physical Activity No Coach[2]	-0.303	0.005	0.739	0.599	0.912
TV Frequency[4]	0.255	0.043	1.291	1.008	1.654
Breakfast[5]	-0.194	0.054	0.823	0.676	1.003
Sex[6]	-0.614	0.001	0.541	0.381	0.769
Income[7]	-0.092	0.056	0.912	0.830	1.002
Education[8]	-0.276	0.005	0.759	0.626	0.920

[1]% allowed lunch items reported by principals; [2] Physical activity without a coach frequency in the last year; [3] Frequency of physical activity with a coach in the last year; [4;]TV hours in a week; [5]Student reported breakfast frequency; [6]Student sex; [7]Parent income; [8]Parent education

Physical activity was a predictor of obesity (p=0.005) indicating that students who more frequently participated in physical activity were 26.1% less likely to be obese. Television frequency, was a predictor of obesity (p=0.043) indicating that students who spent more time watching television were 29.1% more likely to be obese. Breakfast

frequency was a predictor of obesity indicating that students who consumed breakfast were 17.7% less likely to be obese compared to breakfast skippers. Boys were 46% more likely to be obese than girls, which is consistent with the raw data which also indicated that boys had higher obesity rates than girls. Parental income and education also had significant relationships with obesity, with higher income and education levels being associated with lower rates of obesity.

4.4 Discussion

While previous studies[25,30,52] indicated that students attending a school with a SNP had lower rates of overweight and obesity compared to students attending a school without a policy, this is the first Canadian study to assess the role in SNP adherence in overweight and obesity levels among elementary school children.

Both measures of adherence (perceived and food list) were significant variables in the regression model predicting overweight. The relationship between food list adherence and overweight status was in the expected direction and showed that schools with higher food list adherence scores (greater percentage of 'allowed foods') for lunch items had slightly lower rates of overweight children in their school than schools with lower adherence scores. This finding suggests that a policy controlling the food available in schools can be successful at lowering childhood overweight and obesity rates. The present study results were similar to the results of previous studies[25,49,52,53] and builds on those by showing that stronger policy adherence is related to the rates of childhood overweight. In contrast, the relationship between perceived adherence and overweight was not in the expected direction: principals who perceived higher levels of policy adherence had higher rates of overweight children in their schools. The fact that this

relationship was in the unexpected direction is consistent with results in Chapter 3, where there was a low correlation between perceived and food list adherence. If levels of perceived adherence do not reflect the actual implementation of the SNP, it is not surprising that perceived adherence is a poor predictor of prevalence of overweight. This in turn reinforces the notion that principals need to be aware of how they are implementing policy elements so that the policy will be implemented as intended to positively impact children's health. It must also be noted that perceived adherence measures all elements in the SNP rather than just food offered in schools. It could be possible that the other SNP elements could predict overweight; for example, if students are having breakfast twice because the school has a breakfast program and they also eat at home prior to school, this could impact their weight status.

Both measures of adherence were also included as independent variables in the regression models predicting obesity levels. In contrast to the models predicting overweight, neither perceived adherence nor food list adherence was found to be a significant predictor of obesity status in PEI children. While neither measure of adherence was found to be a significant predictor of obesity, a number of variables (physical activity, TV frequency, breakfast consumption, student sex, parent income, parent education) were significant predictors of both overweight and obesity.

This study corroborates a large body of research[10,24,27,30,37,38] and included a number of factors that have been identified as increasing the risk of childhood overweight and obesity. Diet and physical activity have been identified as two main contributors to overweight and obesity.[1,10,11,13] An individual's dietary intake and behaviours have been known to impact the risk of overweight in a number of ways such

as skipping breakfast, consuming more snacks or beverages high in fat and/or sugar, consuming less than 5 fruit and vegetables a day.[25] In order to consider the possible association with children's diet and overweight levels, this study included breakfast consumption, LNDF consumption and fruit and vegetable consumption as predictors in the analysis. Results are consistent with a Nova Scotia study that reported that students who consumed breakfast on a more frequent basis were less likely to be overweight and obese.[25] The present research assessed whether a student consumed breakfast or not, but was not able to indicate whether students consumed breakfast at home or through a school breakfast program. It was reported in Chapter 3 (pg.31) that a large number of principals reported offering a breakfast program in 2010. However, it cannot be inferred that schools offering a breakfast program were less likely to have overweight or obese students because it is unknown how often breakfast programs were offered at schools, or how many students utilized the program.

The relationship between LNDF (French fries, cakes, candy soft drinks) consumption and overweight was in the expected direction as children consuming fewer (0-3 servings) foods such as cookies and potato chips on a daily basis had lower levels of overweight. However, LNDF consumption was not found to be a significant predictor of obesity rates in this research. This is somewhat consistent with a Nova Scotia study[25], which reported that students consuming more sugar-sweetened items and less fruit and vegetables per day are more likely to be overweight and obese However, the present research did not find that fruit and vegetable consumption was a significant predictor of overweight or obesity.

Another known contributing factor to overweight and obesity is the level of

physical activity.[9,38] It has been found that children are less active than in the past, possibly due to more sedentary activities such television viewing, playing video/computer games.[37,38] Both models (overweight and obese) included the frequency of physical activity with and without a coach in the past year and frequency of weekly television viewing and computer use. Higher levels of student-reported physical activity were associated with a lower likelihood of being overweight and obese. This finding is consistent with previous research which found that more time spent doing physical activity was associated with lower rates of overweight and obesity.[9,37,38] Screen time was removed from the final models because it was not significantly associated with overweight levels. This may reflect the low level of variability in student-reported screen time (SD computer use=0.90, SD television use=0.96), with 15% of student reporting more than 2 hours a day on the computer and 30% of students reporting more than 2 hours of television viewing.

In conclusion, it is known that there are a number of factors contributing to overweight and obesity rates among children. Although childhood overweight and obesity cannot be completely prevented or eliminated because of changes in the school food environment, the results of this study showed that when schools implement a nutrition policy as it was intended, it can play a role in reducing childhood overweight and obesity levels.

Chapter 5: Conclusions

This research study is the first in Canada to assess the relationship between the level of adherence to a school nutrition policy (SNP) and elementary school children's overweight and obesity rates. This was also the first Canadian study to assess in a comprehensive manner SNP adherence in all elementary schools in the province and the changes in the level of adherence to a SNP from 2007 (early policy implementation) to 2010 (four years after implementing the policy).

Objective 1:

Results indicated that principals perceived they were following SNP elements more closely in 2010. In contrast, the level of food list adherence declined significantly from 2007 to 2010. It is important to note that in both time periods, the lowest percentage of 'allowed' food and beverages was observed for the school lunch program, which is the school food environment that is offered at all schools.

Objective 2:

This study examined food list adherence in all school food environments because previous studies have shown that adherence varies among school food environments and students change the location of where they purchase 'not allowed' items when all environments do not consistently adhere to policy guidelines.[20-22,29] These studies also found that beverage policies tended to be followed more closely than food policies because of policy wording. [20-22,29] Beverage policies tend to be written with guidelines indicating which specific beverages are allowed, while food policy guidelines specify

nutrient criteria to determine if each item is 'allowed' to be served. The nutrient criteria can be difficult to understand by an untrained individual, but it can also be difficult to determine the nutrient content of food items that come from smaller local establishments compared to larger corporate suppliers. The findings in this study were not consistent with American studies[20,21,29] since the lowest levels of food list adherence were for items offered through the lunch programs. The high levels of policy adherence for lunch items reported by previous studies likely reflects the fact that they were conducted in the United States where a government-funded national lunch program is in place in all schools with very strict guidelines. Vending machines in PEI had the highest level of food list adherence; this finding is consistent with past research[20,21,29] regarding high adherence to beverage policies as vending machines in PEI elementary schools only offer beverages.

Objective 3:

This study also examined the agreement between perceived adherence and food list adherence. It was important to assess this relationship because the changes over time for these two measures were not consistent from 2007 to 2010; principals' perceived adherence improved over time while the food list adherence decreased. The relationship between perceived adherence and food list adherence was used to determine if principals are implementing the policy to the extent they perceive to be. The relationship between perceived adherence and food list adherence revealed that principals might be aware of how well they are adhering to certain elements. For example, principals who reported frequently serving foods from the 'Most Often' and 'Sometimes' lists had higher food list adherence rates. Similarly, principals who reported adhering frequently to other

policy elements, such as having pricing strategies to encourage children to select healthy foods, and healthy advertising also had higher food list adherence rates. This suggests that for some aspects of the policy, the self-report method is a valid representation of how the policy is being implemented. It is important to note that a higher percentage of 'allowed' items being available at school does not necessarily mean that students will choose the healthy option. However, if principals are able to implement the other elements as they were intended, students will be even more inclined to choose the healthier option if it is attractively priced and/or promoted at school.

Objective 4:

The second objective examined the relationship between the level of SNP adherence and children's overweight and obesity rates. The association with food list adherence (the more objective measure) and overweight rates was in the expected direction, as schools with higher food list adherence scores had lower rates of overweight. In contrast, the relationship between the levels of perceived adherence and childhood overweight was in the opposite direction: schools with higher levels of perceived adherence had higher rates of childhood overweight. This finding may be explained by the positive association between food list adherence and perceived adherence observed in 2007 but not in 2010 when there was a negative association between the two measures: perceived adherence actually increased as food list adherence decreased. This explains why the two measures of adherence had opposite relationships with overweight and obesity rates in 2010.

Even though there was a significant decrease in food list adherence from 2007 to

2010, this study still found a modest but significant relationship between the objective measure of SNP adherence and children's overweight rates in 2010. This finding indicates that, when followed, SNPs have the potential to positively impact the weight status of children. This study also found a statistically significant positive relationship with perceived adherence and overweight rate. This indicates that schools with higher levels of perceived adherence also had slightly higher rates of overweight. However, there was no significant relationship between either measure of SNP adherence and childhood obesity rates. The results of the present study are similar to the findings in an American study, which examined the effects of a SNP on the prevention of overweight and obesity using various assessments of SNP implementation. This study found a reduction in overweight and lower prevalence of overweight in two years in the intervention schools compared to control schools.[22] Similarly, no differences were observed in the incidence or remission of *obesity* in two years. Foster et al suggested that progression to or remission from BMI in the 95th percentile may be more likely to result from clinical-based programs rather than untargeted approaches such as SNPs.[27]

The relationship between perceived adherence and childhood overweight was not in the expected direction. This may be due to principals being unaware of how to implement each policy element as intended. This emphasizes how important it is for principals to be aware of how they are implementing the SNP elements because those who perceive their schools to be doing well actually had higher rates of overweight children in 2010. Alternately, it could reflect inflated levels of policy adherence due to principals' social desirability bias.[50,57]

In addition to SNP adherence, there was a number of other predictor variables

included in the regression model to account for several other primary contributors to childhood obesity. Physical activity, breakfast frequency, LNDF daily consumption, student sex, and parent education were identified as significant predictors of overweight and the relationships were in the expected direction consistent with the literature. It was important and necessary to include the predictor variables so the impact of SNP adherence on weight status could be shown in relation to known contributors. Even with the number and strength of predictor variable relationships in the model, the level of SNP adherence remained a significant predictor of childhood overweight. This study included measures of socio-economic status and education levels of parents, an identified limitation in Mullaly et al's earlier study of PEI SNPs in 2006.[23] Another strength of this study was the high response rate: 93% and 95 % principals participated in 2007 and 2010, respectively, representing elementary schools across the entire province of Prince Edward Island. Further, approximately 60% of students participated in the weight measures, which is also considered more than acceptable.[58]

Since this research is correlational rather than experimental in nature, conclusions related to causality are not possible. It was also not possible to randomly assign schools to adopt or not adopt the policy since all PEI elementary schools adopted the policy in 2006. However, this is the case for the majority of jurisdictions across Canada. Since this study examined and compared the levels of SNP adherence over two time periods, it was beneficial to have all schools implementing the same policy guidelines. Another limitation of this study would be the potential recall error from students and principals due to the self-reported measures.[23] Students were asked to recall the number of times they consumed the twenty-five items on the food questionnaire in a

week. In order to reduce recall error, trained research assistants were present during the completion of the student survey to assist in recall and identifying of items. Principals were asked to report the foods available in each school food environment. In order to reduce error and possible social desirability bias, principals were assured that their responses were confidential, and were contacted by a research assistant to verify the information recorded. Finally, results may not be generalizable to ethnically diverse urban populations as PEI is more culturally homogeneous than some other provinces.[59]

Future Research Considerations:

This study has contributed to the knowledge concerning SNPs in Canada and showed that when SNP elements are adhered to, they can have a positive impact on children's overweight status. This study has also identified the need for future research in SNP evaluation. Research is needed to identify policy supports to reduce barriers to SNP adherence, which include resistance to change, lack of resources, profit losses and lack of knowledge or skills.[28,30,52] Consistently monitoring the level of SNP adherence is also needed to determine a) adherence rates after policy supports were implemented and b) if improved adherence rates across the province strengthened the relationship between policy adherence and overweight, an indication if the policy 'dose' were sufficient.[25,30] Another future consideration to build on this research would be the development of more objective tools to assess adherence to policy elements other than the food list (ie. types of healthy advertising materials or principals reporting the prices of lunch items available). A tool to objectively assess these other SNP elements would assist in assessing the agreement between principals' perceived adherence to elements and how all SNP elements are actually being implemented, similar to the agreement assessed in

Chapter 3 using food list adherence and the self report "how often do you offer items from the Most Often and Sometimes list?" Having objective tools to measure and assess other policy elements would assist in improving adherence rates because element specific supports could be provided.

This study assessed the agreement between policy elements and food list adherence to lunch program items. The findings suggest that that the supports needed to improve adherence vary depending on each school's need and that lack of policy education may not be the only barrier. It would be beneficial to replicate the mixed methods study by MacLellan et al's[28] to see whether identified barriers to SNP implementation have changed and what type of support principals would benefit from in order to reverse the decline in adherence rates. While it is useful to highlight which elements schools are not strongly adhering to, childhood obesity rates will not decrease unless the barriers can be overcome and all policy elements can be implemented as intended and adhered to strongly by each school all the time. An on-site audit of schools to monitor the level of adherence to each policy element could reduce principals' self-report and social desirability bias and may reduce the load on schools associated with research. Childhood obesity is also very complex in nature and policy changes regarding the food available at school will not have enough of an impact to reverse the prevalence trends. This is why it is important to implement all policy elements so children can develop healthy lifestyle behaviours for the future so they will become healthy adults.

Future Policy Recommendations

A recommendation based on the results of this study would be identifying an

individual in each school to be the SNP 'champion' or form a nutrition committee with the HEA or other school 'champions'. Principals in this study who reported having a nutrition committee in 2010 had higher rates of food list adherence. This finding is similar to those identified in Downs[47] and Rideout[48] indicating that the presence of a nutrition committee had a positive impact on food and beverage sales. Having individuals dedicated and committed to moving PEI's SNP forward may assist in eliminating a number of barriers to full policy adoption (ie. knowledge, resources, priority) and ensuring that it remains a priority in the school and among staff and students.

In conclusion, the results of this study contribute to the growing body of evidence related to school nutrition policy implementation and evaluation in Canada. It was found that in PEI schools, SNP adherence is decreasing over time based on the results of the more objective food list measure. The increase in perceived adherence in the same time period may reflect the fact that principals are unaware of how to implement each element or are inflating their responses due to social desirability bias. Even though food list adherence declined over time in both the lunch program and canteen food environments, it was found that students attending a school in 2010 who followed the policy more closely had lower overweight rates. This finding can be used to further highlight that support is needed for schools in order for them to successfully follow the policy and lower the rates of overweight and obesity.

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Appendix A- Principal School Food Survey

School **N**utrition and **A**ctivity **P**roject
Principal School Food Survey

Please tell us about the extent to which you are **currently implementing** the following aspects of the Nutrition Policy at your school. Check the box which best represents your opinion.

At my school...

1. We allow a minimum of 20 minutes to eat lunch	Yes ☐	No ☐		
2. We stock an emergency food cupboard with healthy choices for students in need	Yes ☐	No ☐		
3. We participate in the PEI School Milk Program	Yes ☐	No ☐		
4. We offer a breakfast or snack program available to all children	Yes ☐	No ☐		
5. We price foods in a way to encourage healthy food consumption	Disagree ☐	Agree ☐	Strongly agree ☐	
6. Staff and volunteers are familiar with safe food handling practices	Disagree ☐	Agree ☐	Strongly agree ☐	
7. The food and beverages sold in vending machines, which are accessible to students, are selected from the "Healthy Vending Machine and Canteen Foods" list.	Never ☐	Sometimes ☐	Most of the time ☐	Always ☐ NA ☐
8. We promote only healthy food choices and advertising at school	Never ☐	Sometimes ☐	Most of the time ☐	Always ☐
9. We participate in Healthy Eating Alliance, or other nutrition activities when offered	Never ☐	Sometimes ☐	Most of the time ☐	Always ☐
10. We involve students in planning school food choices	Never ☐	Sometimes ☐	Most of the time ☐	Always ☐
11. Foods sold or provided at school are selected from "Foods to Serve Most Often" or "Foods to Serve Sometimes" lists and meet the nutrition policy criteria	Never ☐	Sometimes ☐	Most of the time ☐	Always ☐
12. School fundraising activities emphasize non-food or healthy food products	Never ☐	Sometimes ☐	Most of the time ☐	Always ☐
13. Our staff participate in professional development which addresses nutrition and food issues when available	Never ☐	Sometimes ☐	Most of the time ☐	Always ☐
14. Teachers and school staff act as positive role models with regards to healthy eating	Never ☐	Sometimes ☐	Most of the time ☐	Always ☐
15. We only offer non-food items as rewards for good behaviour, achievement or participation in fundraising activities	Never ☐	Sometimes ☐	Most of the time ☐	Always ☐
16. We have a designated nutrition committee to oversee our schools healthy eating practices.	Yes ☐	No ☐		

17. A) Does your school currently offer a **LUNCH PROGRAM** on any day during the week? **YES** **NO** (Go to Question #18)

B) If your school does offer a **LUNCH PROGRAM**, please fill in the following information regarding the foods offered:

Food Offered	How Often? (# Days Week/month)	What Brand? (i.e.,brand name, restaurant provider, producer)	What Type? **Please be specific.** (e.g., flavour, variety, toppings)
Example: pizza	2/week	Pizza Delight	Pepperoni, white crust 1/month Chicken, whole wheat crust 1/week
hot dogs	1/month	Maple Leaf	Original, all beef
Pizza			
Subs			
Hot Dogs			
Chicken Nuggets			
Chicken Burgers/Hamburgers			
Sandwiches, wraps			
Baked Potatoes			
Soup, chili			
Spaghetti, macaroni, pasta			
Other: Please specify			
Other: Please specify			
Other: Please specify			
Other: Please specify			

Appendix B- Foods to Serve Most Often: Serve Daily

Vegetables and Fruit	**Grain Products**	**Milk and Alternatives**	**Meat and Alternatives**	**Combination Foods***
- Fresh vegetables and fruit Frozen vegetables (no added fat) - Low sodium canned vegetables Tomato sauce (low in sodium) Vegetable soups (homemade, frozen or canned, low fat/low sodium) Vegetable stir-fried,Baked, boiled or mashed potatoes (with little or no fat) Green salads (without high fat dressing) - Canned fruit (packed in 100% juice or water), 100% dried fruit (e.g. raisins, cranberries) 100% fruit/veggie leathers or bars (no sugar added), Applesauce or fruit blended applesauce products (no sugar added), Frozen fruit (no sugar added) Frozen fruit bars (100% real fruit juice) Fruit smoothies (made with real fruit or 100% fruit juice), 100% fruit or vegetable juice or 100% juice blends	-100% whole grain or whole wheat breads, buns, rolls, bagels, English muffins, pita bread, wraps, tortillas, bannock, naan, roti, waffles, pancakes or pizza dough -Whole grain, whole wheat crackers, breadsticks or flatbreads (low fat) -Whole grain, unsweetened or low-sugar, ready-to-eat cold cereals -Hot cereals (e.g. oatmeal) -Rice cakes, plain popcorn -Corn bread -Whole wheat noodles or pasta -Brown or wild rice -Barley, bulger, quinoa, or other whole grains -Low fat, high fibre muffins made with vegetables or fruit -Cookies (made with oatmeal or dried fruit and whole wheat flour)	-White or chocolate milk, 2% milk fat (M.F.) or less -Flavoured milks (2% M.F. or less, 28 g sugar/ 250 mL) -Soya beverages (original and flavoured, 2% M.F. or less) -Fresh or frozen yogurt (2% M.F. or less) -Yogurt tubes (2% M.F. or less) -Cheese (21% M.F. or less; e.g. part skim mozzarella, cheddar) -Cheese strings (21% M.F. or less) -Cottage cheese (2% M.F. or less) -Milk-based soups and chowders (2% M.F. or less; homemade, or canned low fat/low in sodium) -Smoothies made with milk products (2% M.F. or less)	-Chicken or turkey (unbattered) -Fish or seafood (fresh or frozen, unbattered) -Lean or extra lean beef or pork -Low sodium lean deli meats (ham, chicken, turkey, roast beef) -Meatballs or meatloaf made with lean or extra lean meat -Canned fish (packed in water) -Eggs or egg substitutes -Tofu -Legumes (e.g. beans, peas and lentils) -Bean based dips (e.g. hummus) -Peanut butter -Soy nut or almond butter -Nuts and seeds (unsalted)	-Stir fries (chicken/beef/vegetable) -Fajitas, quesadillas, soft tacos (made with whole wheat wrap) -Wraps/pitas (made with whole wheat shell) -Submarine/sandwiches with lean deli meats made with whole grain breads -Grilled cheese sandwich (made with whole wheat bread, lower fat cheese) -Meatballs and brown rice/whole wheat noodles -Spaghetti or macaroni and cheese (made with whole wheat noodles) -Shepherds pie -Cabbage rolls -Salads (vegetable, pasta, etc.) -Soup, stew or chili -Noodle or rice soup (homemade or canned low fat/low sodium) -Cheese/veggie/chicken pizza made on whole wheat crust -Panzarotti with vegetables and lower fat cheese -Souvlaki -Falafel (not fried) -Yogurt (2% M.F. or less) and fruit parfaits -Trail mix ***Foods in this category should be made with 'Serve Most Often' ingredients***

Use these Nutrient Criteria:

Total Fat: **Maximum 5 g per serving –** Vegetables and Fruit, Grain Products & Milk and Alternatives
Maximum 10 g per serving – Combination Foods & Meat and Alternatives, with the e*xception* of the following*:*
- If permitted, schools can serve peanut/nut butters, and unsalted/unsweetened nuts and seeds (not roasted in oil).

Saturated Fat: Maximum 3 g per serving
Trans Fat Free: Maximum 0.5 g per serving
Fibre: **Minimum 2 g per serving** - This applies only to grain products, and with exception of the f following:
-Brown or wild rice is exempt from fibre criteria. A minimum of 1.5 g fibre per serving is permitted for whole grain/whole wheat breads.
Sugar: **Maximum 10 g per serving** - with the *exception* of the following:
-Fresh vegetables and fruit, canned vegetables and fruit (packed in water/100% juice), frozen vegetables and fruit, 100% dried fruit, 100% vegetable and fruit juices may contain natural sugar exceeding 10 g per serving.
-Lower fat (2% M.F. or less) flavoured milks may contain a maximum of 28 g sugar per 250 ml serving.
-Lower fat (2% M.F. or less) yogurts may contain a maximum of 15 g sugar per 100 g serving.

Sodium: **Maximum 200 mg per serving** - Vegetables and Fruit, Grain Products, Milk and Alternatives & & Meat and Alternatives
Maximum 480 mg per serving - Combination Foods

Appendix C- Foods to Serve Sometimes: Serve No More Than 2 Food Items From Each Column Per Week

Vegetables and Fruit	**Grain Products**	**Milk and Alternatives**	**Meat and Alternatives**	**Combination Foods**
-Regular canned vegetables, drained -Vegetables with sauces (e.g. cheese sauce) -Vegetable soup (canned, frozen, regular) -Canned fruit (in light syrup) -Applesauce or fruit blends with sugar added -Fruit crisps (e.g. apple, strawberry- rhubarb) -Oven baked french fries ** Choose* *no more than 2 food items from this list per week*	-White, 60% whole wheat, enriched breads, buns, rolls, bagels, English muffins, pita bread, wraps, tortillas, bannock, naan, waffles, pancakes or pizza dough -Bread stuffing -Loaf breads or sweet breads (e.g. banana, zucchini, pumpkin) -Sweetened cereal made with oats or whole grains -Cereal bars and granola bars (low fat) -Cereal snack mix -Non whole grain crackers -Low fat cookies -Graham wafers or digestive cookies -Melba toast or white bread sticks -Biscuits, scones, or bannock -Pretzels -Fruit bars (e.g. fig newtons) -Date squares -White or flavoured noodles or pasta -White rice or rice noodles -Couscous ** Choose* *no more than 2 food items from this list per week*	-Whole milk -Ice milk -Hot chocolate made with milk (2% M.F. or less) -Milk based puddings -Yogurt and yogurt drinks (more than 2% M.F.) -Frozen yogurt (more than2% M.F.) -Yogurt dips -Cheese (>21% M.F. and <32% M.F.) -Processed cheese products (e.g. slices, spreads) -Custards ** Choose* *no more than 2 food items from this list per week*	-Baked chicken/veggie burgers or nuggets; battered and not fried -Baked fish; battered and not fried -Fish canned in oil -Baked ham -Nuts and seeds (salted) ** Choose* *no more than 2 food items from this list per week*	-Lasagna -Macaroni and cheese (made with white noodles) -Pastas made with cream sauces -Grilled cheese (made with white bread) -"Salad-type" sandwiches made with full fat mayonnaise (e.g. egg, tuna, chicken) -Soups, (canned, regular) -Lower fat hot dogs or veggie dogs with bun - Noodle or rice soup (canned or instant) -Pizza with lean meats (ham or ground beef) made on white crust -Hard tacos -Sloppy Joes -Garlic bread, garlic slice, garlic fingers (made with lower fat cheese, <21% M.F.) -Quiche ** Choose* *no more than 2 food items from this list per week*

Use These Nutrition Criteria:

Total Fat:	**Maximum 10 g per serving**
Saturated Fat:	**Maximum 6 g per serving**
Trans Fat Free:	**Maximum 0.5 g per serving**
Fibre:	**Less than 2 g per serving for grain products.** This criteria applies to only grain products, with the exception of less than 1.5 g for bread products.
Sugar:	**Maximum 20 g per serving**
Sodium:	**Maximum 480 mg per serving** - Vegetables and Fruit, Grain Products, Milk and Alternatives & Meat and Alternatives **Maximum 1000 mg per serving -** Combination Foods

Appendix D- Foods to Serve Least Often: Serve These Foods Infrequently

(Serve No More Than 2 Food Items from This Entire List per Month)

Vegetables and Fruit	Grain Products	Milk and Alternatives	Meat and Alternatives	Combination Foods	Other
-Fried vegetables -Deep fried french fries -Fruit drinks and juices with less than 100% real fruit juice -Canned fruit in heavy syrup -Fruit pies -Fruit leather (made with less than 100% real fruit)	-High fat muffins (cake-like, commercially prepared) -Sweetened breakfast cereals -Crackers (not low fat) -Granola bars (dipped, not low fat) -Cookies (commercial or higher fat, regular recipe) -Noodles (canned or instant "fried type") -Toaster pastries, pop tarts	-Cream soups, regular -Milkshakes -Ice cream, regular -Frozen novelty ice cream (e.g. Drumsticks) -Cheese (>32% M.F.)	-Regular fat processed meats (e.g. pepperoni, salami, bacon, bologna, etc) -Sausages, regular -Battered/ breaded, and fried meat, fish or chicken (e.g. deep fried chicken nuggets/ burgers) -Regular ground beef -Sesame snaps	-Pizza with processed meats (e.g. pepperoni, salami, bacon) -Hot dogs, regular with bun -Bacon, Lettuce and Tomato (BLT) sandwiches -Noodle soup (canned or instant "fried type") -Donairs -Chicken wings -Egg rolls, fried -Poutine -Fries with the works	-Potato or nacho chips -Sun Chips -Chocolate bars -Pastries, pies and cakes -Doughnuts -Squares (e.g. brownies) -Candy -Soft drinks (carbonated soda) -Iced tea -Lemonade -Sweetened fruit drinks -Sports drinks -Slushies, regular -Popsicles and freezies -Frozen fruit bars (less than 100% real fruit juice) -Hot chocolate made with water -Meal replacement bars, protein/energy bars

Use These Nutrition Criteria:

Total Fat:	**More than 10 g per serving**
Saturated Fat:	**More than 6 g per serving**
Trans Fat:	**More than 0.5 g per serving**
Fibre:	**Less than 2 g per serving -** Criteria applies to only grain products
Sugar:	**More than 20 g per serving**
Sodium:	**More than 480 mg per serving** - Vegetables and Fruit, Grain Products, Milk and Alternatives & Meat and Alternatives **More than 1000 mg per serving -** Combination Foods

Appendix E: Frequency distributions for all statistically significant regression variables

Student-reported breakfast frequency

	Frequency	Valid Percent
Breakfast Skippers	439	26.8
Breakfast Consumers	1201	73.2
Total	1640	100%

Student sex

	Frequency	Valid Percent
Boy	765	46.7
Girl	874	53.5
Total	1639	100

Student grade

	Frequency	Valid Percent
Grade 5	834	50.7
Grade 6	811	49.3
Total	1639	100

Student physical activity- coach

	Frequency	Valid Percent
Never	259	15.8
Less than once a week	123	7.5
1 to 3 times a week	680	41.5
4 or more times a week	575	35.1
Total	1637	100

Student physical activity- no coach

	Frequency	Valid Percent
Never	38	2.3
Less than once a week	89	5.4
1 to 3 times a week	427	26.0
4 or more times a week	1086	66.2
Total	1640	100

Student daily computer use

	Frequency	Valid Percent
Less than one hour a day	758	46.4
1-2 hours a day	615	37.7
3-4 hours a day	179	11.0
5-6 hours a day	49	3.0
7 or more hours a day	32	2.0
Total	1633	100

Student daily television use

	Frequency	Valid Percent
Less than one hour a day	381	23.3
1-2 hours a day	728	44.6
3-4 hours a day	388	23.7
5-6 hours a day	82	5.0
7 or more hours a day	55	3.4
Total	1633	100

Parent education

	Frequency	Valid Percent
No schooling	2	0.1
Elementary	22	1.3
Secondary	309	18.5

Community college	728	43.6
University	364	21.8
Graduate	244	14.6
Total	1669	100

Parent income

	Frequency	Valid Percent
Less than $20,000	69	4.1
$20,001 to $40,000	248	14.7
$40,001 to $60,000	236	14.0
$60,001 to $80,000	234	13.9
More than $80,001	456	27.1
Total	1243	100

LNDF consumption

	Frequency	Valid percent
Inadequate (more than 3 servings	284	17.4
Adequate (less than 3 servings)	1351	82.6
Total	1635	100

Fruit and vegetable consumption

	Frequency	Valid percent
Inadequate (more than 3 servings	1418	86.4
Adequate (less than 3 servings)	223	13.6
Total	1641	100